SMOKELESS BOILER NUMBER

OCT 19 1916

THE HEATING AND VENTILATING MAGAZINE

Vol. XIII. No. 10
$1.00 a year. 10 cents a copy

NEW YORK, OCTOBER, 1916

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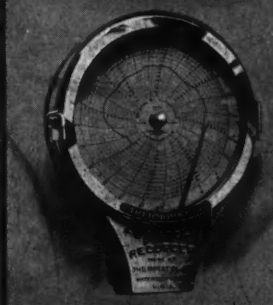

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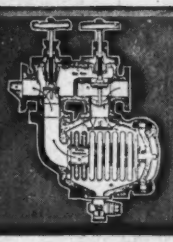

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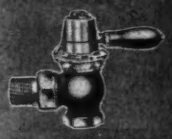

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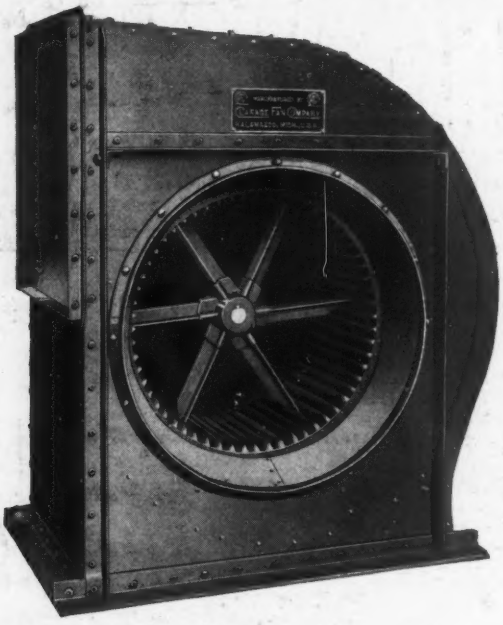

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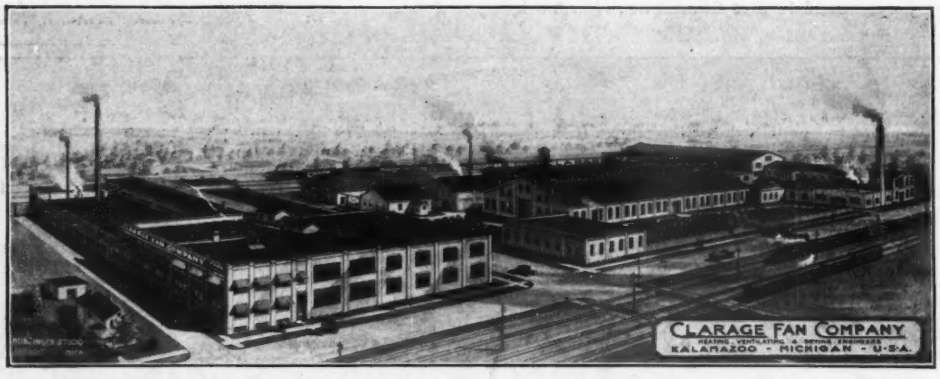

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK OCTOBER, 1916

The Development of the Smokeless Boiler

High Efficiencies of this Type Based on Better Combustion, As Well As On Cheaper Coal, with Higher Heat Values.

By CHARLES L. COLLETTE.

About 20 years ago William Kent wrote a book called "Steam Boiler Economy." In this book he made several recommendations regarding proper methods of burning soft coal smokelessly. Even at that early date the smokeless burning of soft coal was not a new idea, but was rather something that had been done for a number of years.

Two factors were of prime importance in the development of the smokeless boiler. The scarcity of hard coals and their consequently rapid increase in price, particularly in the Middle and Western States, and the passing of various ordinances prohibiting smoke.

These two prime factors working hand in hand meant that one of two things must happen. Efficient methods for burning soft coal smokelessly must be developed or the owners of buildings were bound to find their coal costs constantly increasing, possibly to a prohibitive point.

The early engineers had no difficulty in learning the cause of smoke and it was agreed that it was due to imperfect combustion of the gases which make up the bigger proportion of the heating value of soft coals. And it was very early learned that the elimination of smoke, which could only be accomplished by the complete burning of all of the gases, meant the elimination of waste and lower coal bills.

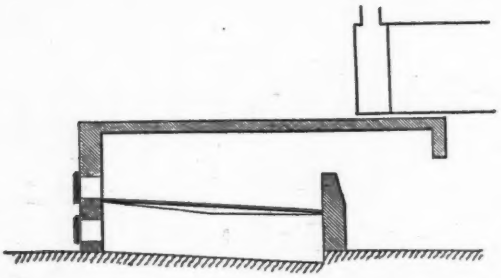
It is not difficult to see just why the ordinary type of boiler of 20 years ago could not burn soft coal efficiently or smokelessly. Practically all boilers were of the up-draft type. The coal was fed onto rocking grates of various kinds and the fresh fuel as needed was thrown on top of the fire.

The natural consequence of adding fresh fuel to the top of the fire was to produce the following result. The heat of the fire under the fresh fuel caused the gases in the fresh fuel to distill. This distillation of gases occurred in a chamber which was not hot enough to ignite these gases. Upon striking the comparatively cool water surfaces of the boiler they were condensed into smoke and passed up the stack unburned.

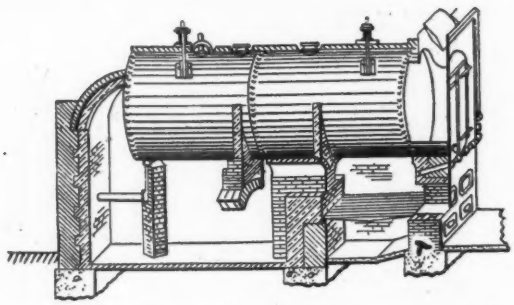
EARLY TYPES OF SETTINGS FOR OBTAINING SMOKELESS COMBUSTION.

Various arches and combination linings of fire brick were first used to solve this problem. The theory was that by surrounding the combustion chamber with fire brick it would absorb sufficient heat to keep the combustion chamber at high enough temperature to ignite the distilled gases. Various settings of tubular boilers were arranged. Dutch oven furnaces with deflector arches and, finally, furnaces equipped with Dutch ovens and deflector arches set flush with the front of the boiler.

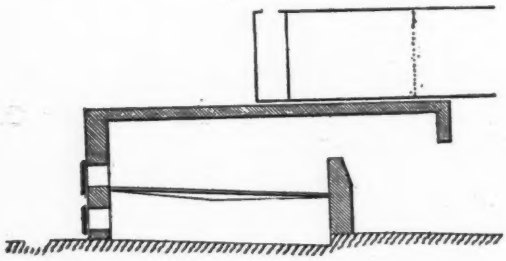
This solution did not prove practical.



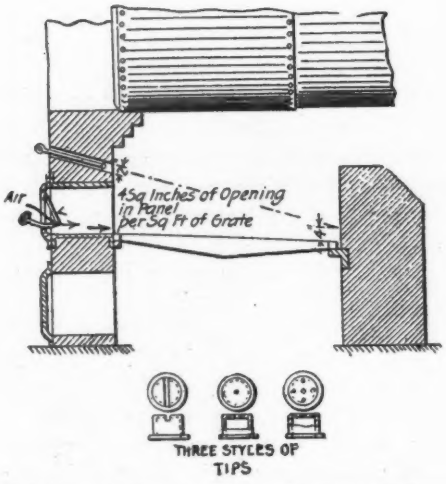
Flush Front Dutch Oven Furnace With Deflector Arch.



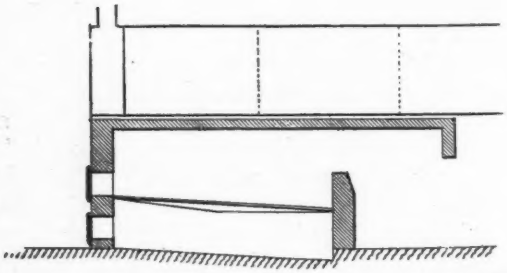
Double Arch Bridge Wall Setting for Two-Course Boiler.



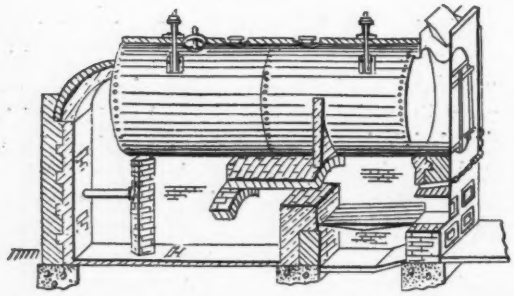
Semi-Extension Dutch Oven Furnace With Deflector Arch.



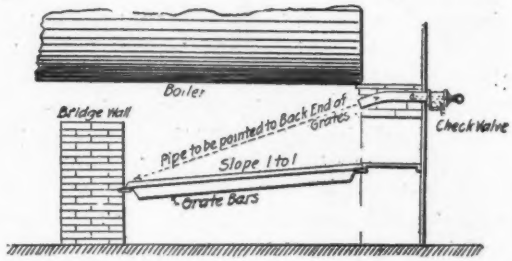
Details of Steam Jet and Panel Doors.



Full Extension Dutch Oven Furnace With Deflector Arch.



Single Arch Bridge Wall Furnace With Single-Span Deflector Arch.



Cincinnati Steam Jet for Low Settings.

VARIOUS SETTINGS OF TUBULAR BOILER TO SECURE SMOKELESS COMBUSTION.
(Compiled by Osborn Monnett, American Radiator Co., Chicago, Ill.)

It usually required more space, either in area or height, than was obtainable in the ordinary boiler room. The fire brick linings were expensive to maintain and it developed that while these various fire brick linings kept the combustion chamber at a higher temperature, it served to distill the gases from the fresh fuel more rapidly, without, in many cases, providing a temperature high enough for complete ignition of these gases.

In his book on "Steam Boiler Economy," Professor Kent makes the following recommendation, in speaking of the ordinary up-draft furnaces where fresh coal is fed on top of the fire:

"If the direction of the draft can be reversed, the air being admitted above the coal and passing down through it and through the grate, the character of the operation of the furnace is completely changed. The cold air and the cool distilled gases pass together down through the hot coke, and if the air supply is sufficient, the gases will be thoroughly burned and smoke will be prevented. To prevent the burning of the grate-bars they are made of water-tubes, which are connected by headers with the boiler so as to insure a positive circulation of the water through them."

PRINCIPLE OF HAWLEY DOWN-DRAFT FURNACE.

The down-draft princple for the complete and smokeless burning of soft coal recommended and described by Wililam Kent about 20 years ago embraces the principle of what was then known as the Hawley down-draft furnace. At that time this type of furnace had been in use for several years and had proven its ability to burn soft coal smokelessly with the consequent fuel saving.

The principle of the Hawley down-draft furnace is one which is now used by practically all makers of smokeless boilers. The firebox or combustion chamber is equipped with two grates. The upper grate, which is a water grate to prevent burning, is the firing grate. The secondary grate is below the firing grate and merely serves as a receptacle for the coked coal dropping onto it from above. The furnace is so arranged that the draft instead of passing up through the fire and then through the fresh coals; passes first through the fresh coals, then down through the fire and hot coals on the upper grate. Reversing the draft in this manner carries the freshly distilled gases down through the fire and through the hot combustion chamber between the upper and lower grates, operating to completely burn all of the gases before they come into contact with the water surfaces of the boiler.

The developments of this idea for the smokeless burning of soft coal have been many. It has been used for power and for heating purposes and furnaces and boilers have been constructed, with this principle, of both steel and cast iron. What was originally only a design for a furnace or combination chamber has been developed so that today the down-draft furnace is one of the features of various makes of boilers which combine the boiler and the furnace.

Smokeless boilers of the firebox type were out of the experimental age many years ago. They have proven particularly adaptable and efficient for the heating of larger buildings.

In the results it has achieved the smokeless boiler has well merited the approval and sanction which is now given to it by all of the leading engineers of the country. In practically every city and town of any size in this country and Canada it is burning the cheapest and poorest of soft coals smokelessly and with a decided fuel saving.

EFFICIENCY RESULTS WITH SMOKELESS BOILERS.

For a good many years engineers had agreed that 75% was the maximum efficiency which could be secured from a low pressure heating boiler. And it was quite thoroughly agreed that 60% was a little better than the efficiency of the average boiler. But actual tests of smokeless boilers have shown a much greater efficiency than has heretofore been possible.

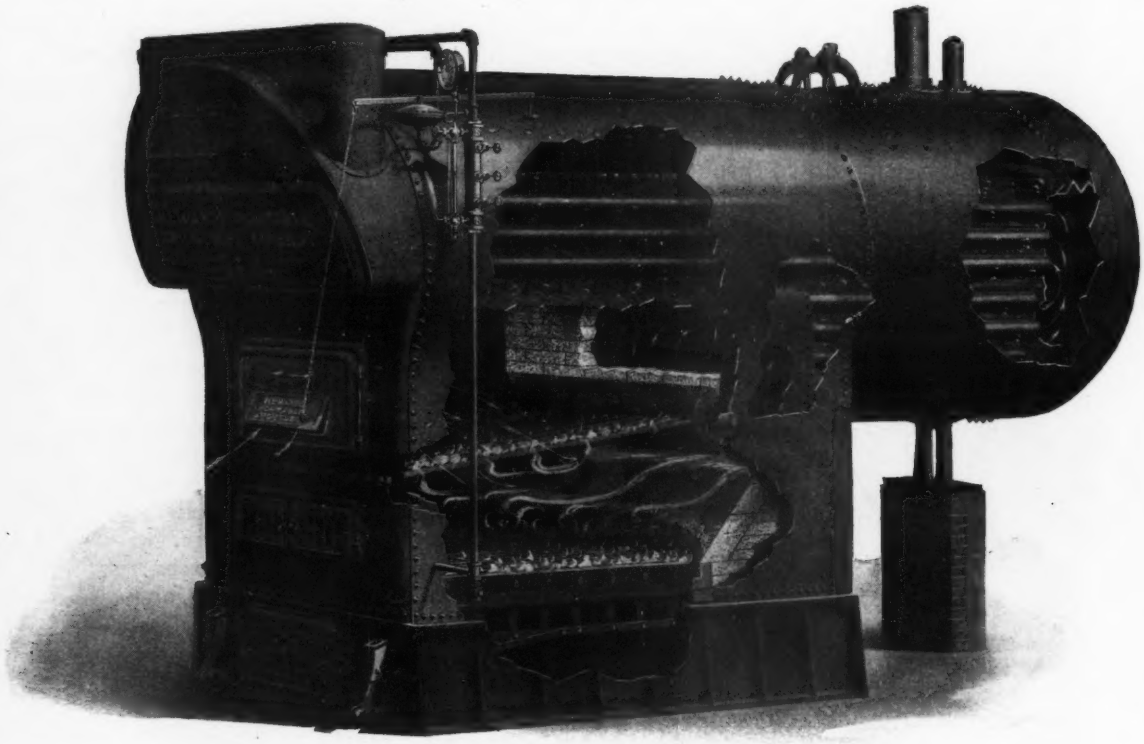
Laboratory tests, and tests in actual installations have proven conclusively that efficiencies ranging anywhere from 70% to 80% can be obtained with unskilled labor in a smokeless boiler of the firebox type. Considering that 60% is a high average efficiency for the ordinary up-draft boiler, this shows that from 10%

to 20% greater efficiency is possible under ordinary conditions with the smokeless type of boiler.

SOFT COAL CHEAPER AND OF HIGHER HEAT VALUE PER TON.

In addition to this saving caused by the greater efficiency in this type of boiler comes the further saving in the opportunity of using cheaper and better coal. It is a well-established fact that a dollar spent for soft coal buys more heat than the same money spent for anthracite. This means that the building owner whose building is equipped with a smokeless type of boiler can cut his coal bills in two ways. First, due to the fact that his boiler will burn any kind of soft coal smokelessly, his coal costs him less money. And the fact that his boiler is capable of burning soft coal perfectly and smokelessly insures elimination of waste and a further fuel saving. Both from the standpoint of economy in fuel and smokeless results the down-draft smokeless boiler is becoming more firmly entrenched every year.

In the latter part of 1914 the Department of Smoke Inspection in the City of Chicago started to enforce a rule that all buildings requiring 1,200 sq. ft. of steam radiation or more must be equipped with a smokeless boiler of some proven and accepted type. This ruling was rigidly enforced for a time and was then rescinded, but in a short time it was again put into effect and it is in effect today.



HAWLEY DOWN-DRAFT PRINCIPLE AS APPLIED TO KEWANEE BOILER, PORTABLE TYPE.

Undoubtedly the action of the City of Chicago is a forecast of what other big cities, and, following the big cities, the smaller cities, will do along the lines of smoke prevention. And the interesting fact is that an ordinance prohibiting smoke and demanding the installation of a smokeles boiler is not a hardship on building owners, but is rather a direct command to them to stop wasting fuel.

Burning Soft Coal Without Smoke; Also Combustion of Coals in General

By FREDERICK T. OAKES, C. E.

The question is often asked, "Can I burn soft coal without smoke?" In answer the writer would say, "Yes, under certain conditions."

In the first place, soft coal in the East is of a different grade from that used in the Middle West and West, but in either location the essentials for burning it without smoke are the amount of air taken in both under and above the grate, as well as the size of openings between the grate bars, and the space for combustion above the fire.

It is an established fact that in the burning of coal there is a gas thrown off which is not generally burned, known as carbonic oxide. The reason this is not consumed is that the oxygen in the air is used up before the surface of the fire is reached. To make up for this lack of oxygen various expedients are resorted to which are more or less successful. One of these is the well-known "Hawley down-draft," which is composed of two sets of grate bars, one above the other. The coals as they are burned drop through the upper bars to the lower bars and there meeting a fresh body of air, the carbonic oxide is burned. Another expedient is to use the ordinary grate and, by taking in air above the fire, obtain the same results. In either of these methods the success of the operation depends on the amount of air and the manner of taking in the second amount of air.

These problems have been worked out both in the laboratory and in actual practice over and over again, but for one reason or another have been abandoned, only to be revived again.

In power plants one great drawback has been graft on the part of the operators at the plant, in others, ignorance of what they were doing or unwillingness to keep the apparatus in order.

In 1865 the same principles were used in the common cooking stove and while those using them wondered at their ability to do more work and get a greater amount of heat while using less coal, this type of cooking stove finally dropped out of sight and the trade went back to the more extravagant method of throwing 40% or more of unburned fuel up the chimney.

Of late the question of getting all that is possible out of fuel has come up, as well as the proposition of using soft coal without smoke, and various heating boiler manufacturers have put out boilers which are claimed to accomplish these feats successfully.

The writer will here draw attention to a method that was used in England in the early part of the last century. Fig. 1 shows a furnace used under a power boiler burning soft coal. In this furnace the heat under the boiler was almost doubled and no smoke was emitted from the stack. Those in charge were able to reduce the size of the grate and still obtain a more steady fire than without this method. It will be observed that air was not only taken through the grate, but was also taken through the bridge into the combustion chamber.

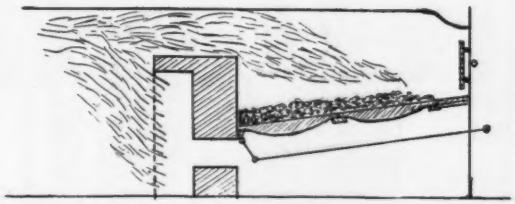


FIG. 1—OLD-TYPE FURNACE USED UNDER POWER BOILER BURNING SOFT COAL.

With the air shut off from the bridge inlet the furnace smoked as previously, but on opening the valve all smoke was eliminated and the heat output nearly doubled.

These results have been obtained many times since in a practical manner and many similar devices are in use today. The writer himself, with a very little change in a heating boiler, has effected a saving of from 10% to 40% in fuel while obtaining the same amount of heat in a number of boilers, and in one instance, made a 16-in. Menlo steam boiler.

rated at 300 sq. ft., supply the equivalent of 595 sq. ft. of direct radiation with no trouble or forcing.

In making this change a small pipe was run inside the smoke pipe, connecting it with the outer air by using a malleable iron elbow. This pipe was extended as near the boiler as posible, between the damper in the smoke pipe and the boiler. In this case the damper controlled the amount of air taken in. The draft plate below the grate was kept as nearly closed as possible, according to the amount of heat required.

The boiler shown in Fig. 2

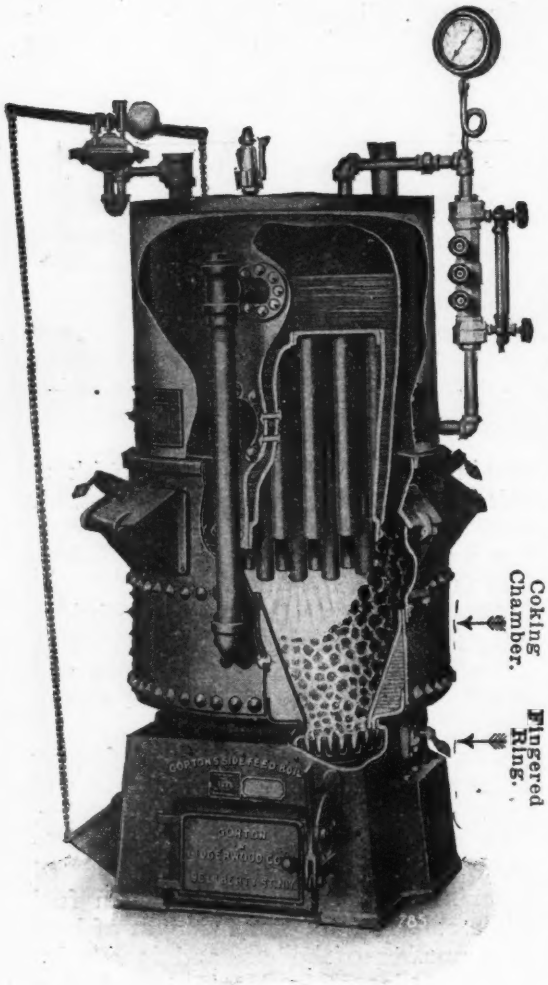


FIG. 2.

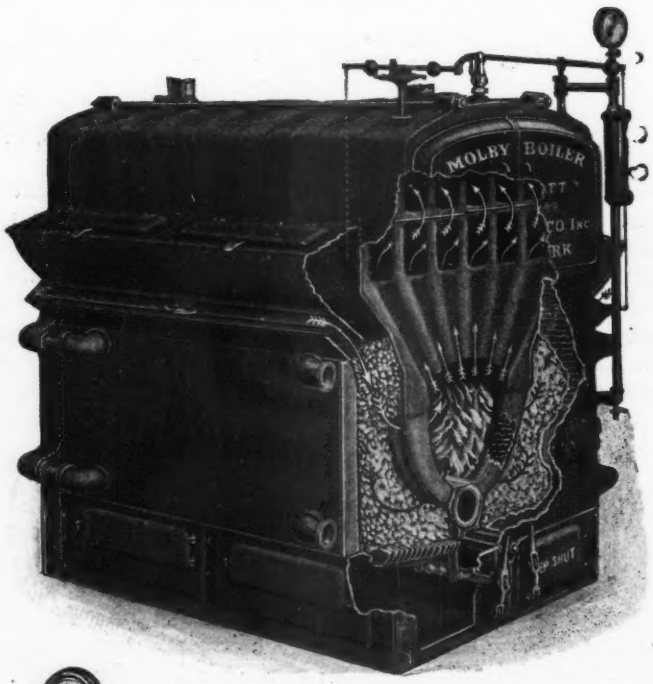


FIG. 3.

will burn soft coal without smoke and requires little or no attention for hours at a time. To do this the boiler is equipped with a fingered ring around the base of the fire above the grate.

The lower part of the shell extends down into the upper part of the water leg and the space between the shell and the water leg is utilized for the coal reservoir and coking chambers. The reservoir is divided into four compartments which form coking chambers in which the coal is coked before it feeds down to the fire. The fire pot is so constructed that the claim is made that sufficient air is drawn through the fingered ring at the lower edge of the coking chamber to ignite all the gases arising from the coking process, both aiding the combustion and preventing the deposit of soot and unconsumed carbon upon the heating surface of the boiler. It is claimed there is no smoke where these boilers are used.

Fig. 3 shows another type of construction which is similar to that made by a number of manufacturers. In this type the air is drawn down through the coal and the boiler sections form an additional grate through which the products of combustion pass to the flue surfaces of the

boiler. It is claimed for these boilers that there is no smoke emitted from the chimney where they are used. The arrows show the direction of the air and gases to the chimney.

In Fig.4 is illustrated the latest type of soft coal boiler, made by another well-known firm, in which there is a so-called mixing chamber beyond the bridge. The writer believes that air is brought into the mixing chamber from the outside, but the manufacturer states that this is not the case. Unless outside air is admitted to the mixing chamber the writer does not believe it practicable to consume the carbonic oxide by this method, as it is absolutely true that in order to do this, it is necessary to produce more oxygen from some point above the fire, it being very difficult to obtain sufficient air for combustion through the grate without forced draft.

In burning hard coal, the principles herein mentioned are just as necessary as when burning soft coal. In the ordinary furnace, the loss in fuel is great, all because the construction of the furnace is such that it is impossible to burn the coal most effectively. Attachments can be made similar to that used on the Menlo boiler which will, in almost all cases, result in obtaining more heat from the same fuel, or the same amount of heat with less fuel.

FIG. 4.

What Is Satisfactory Smoke Abatement?

By MARTIN A. ROONEY,
Chief Smoke Inspector, Smoke Inspection Department, Nashville, Tenn.

A question that deeply concerns the manufacturer of smoke abatement apparatus, the engineer and the public is: What is meant by satisfactory smoke abatement? That is, when can a given furnace stoker or smoke abating device be said to be performing satisfactorily?

The makers' guarantees in regard to smokelessness are so at variance that it is almost impossible to compare one with another, or the guarantee is couched in such language that it is difficult to determine whether or not the furnace fulfills the guarantee after it is installed.

"Our boiler will not produce *objectionable* smoke," "Will not generate smoke," "Will comply with the Smoke Ordinance," "Will eliminate 90 per cent. of the smoke." This is the way some of the guarantees read.

There is little unanimity even among the various smoke ordinances, so that what might satisfactorily comply with the law in one city would be a hopeless of-

fender in another. Therefore, the need of a generally understood, simple method for comparing smoke performances is becoming more and more apparent.

USE OF THE RINGELMANN SCALE.

Among the many methods suggested for measuring the color of the smoke emitted from a stack the Ringelmann scale, on account of its simplicity, has been the most generally used. This scale is used by holding the chart at such a distance from the eye that the black lines and white spaces blend into even shades of color. Then the color of smoke from the chimney is compared with the chart and the number of the scale which most nearly compares with the smoke emitted by the chimney is recorded on a suitable form. Of course, the color of smoke changes and records should be made of the color being emitted for each one-half minute or one-quarter minute period.

Such a record would show in a graphic manner the duration of each emission of smoke from the stack during the time of observation.

Now to compare the average density of the smoke emitted by this stack with that emitted by any other stack, it is necessary to compute the average percentage density of smoke issuing from the two stacks.

This is done by the formula:

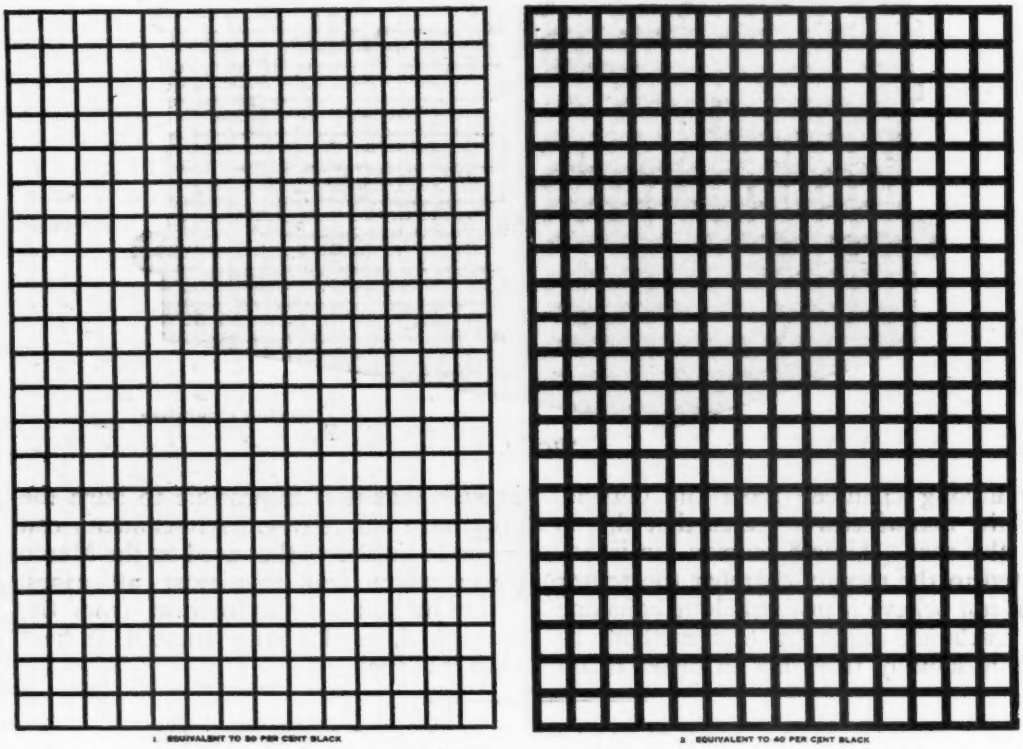
$$\text{Percentage of density} = \frac{\text{smoke units} \times 20}{\text{stack minutes}}$$

in which the various terms are defined as follows:

Percentage of *Density* of smoke is the percentage of light that is prevented from passing through it. For instance, number 4 smoke prevents 80% of light from passing through it; number 1 shuts off 20% of light, etc.

A Smoke Unit corresponds to our minute of number 1 smoke, or its equivalent. One minute of number two smoke is equivalent to two minutes of smoke number one, or equals two smoke units. Two minutes of number 3 smoke equals six smoke units, etc.

Stack Minutes mean the number of



RINGELMANN'S SCALE FOR JUDGING DENSITY OF SMOKE.

minutes one stack is watched. That is, one stack under observation for one minute equals one stack minute, two stacks watched for ten minutes equals twenty stack minutes.

This can be illustrated by an example:—A stack watched for one hour was found to smoke as follows:

Number 5 (dense black) smoke, 2 min.
Number 4 smoke, 1½ min.
Number 3 smoke, None.
Number 2 smoke, 2½ min.
Number 1 smoke, 5 min.
No smoke 49 min.

This is equivalent to:—

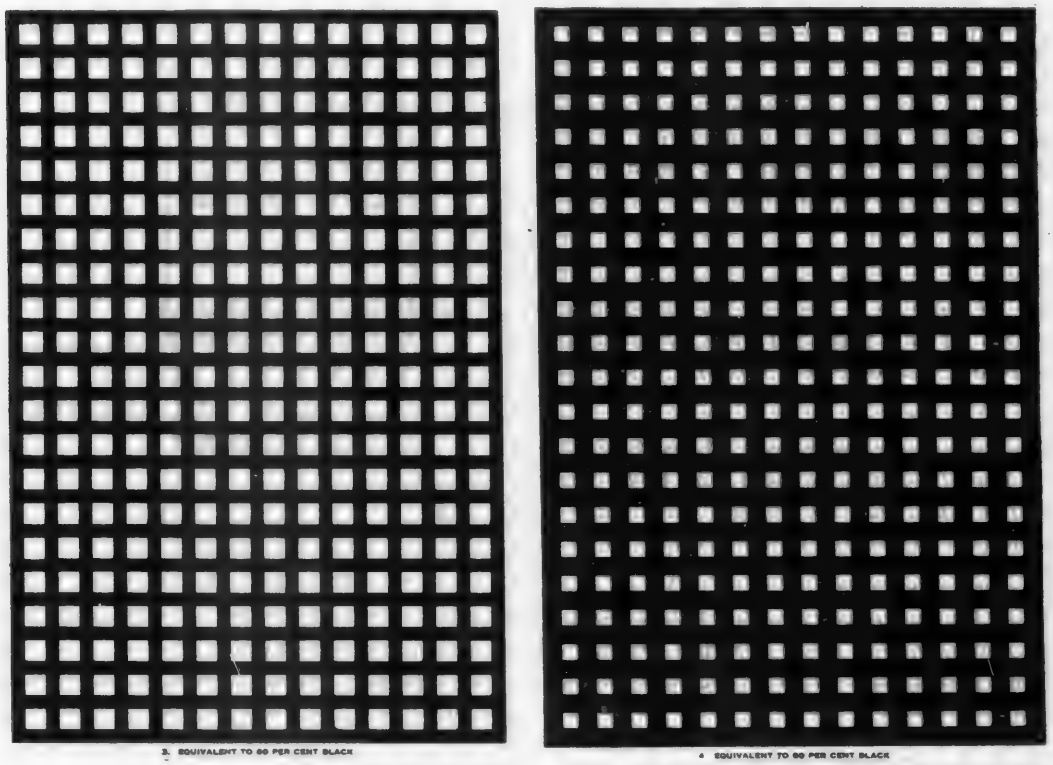
5 × 2 = 10 units
4 × 1½ = 6 units
3 × 0 = 0 units
2 × 2½ = 5 units
1 × 5 = 5 units

A total of 26 units. One stack observed for an hour is equivalent to sixty stack minutes. Therefore the percentage of density equals

$$\frac{26 \times 20}{60} = 8^{2}/_{3}\%.$$

Now a stack may be said to be performing satisfactorily when it *emits not more than 3 minutes of dense smoke (number 3 or greater) in any one hour and when the average percentage density of the smoke emitted in one hour is not greater than 5%.*

After experience with hundreds of smoke preventing devices of all kinds it is the writer's opinion that the above standard is readily obtainable by any type of smoke preventing furnace worthy of the name.



RINGELMANN'S SCALE FOR JUDGING DENSITY OF SMOKE.

An Arrangement for Maintaining Even Combustion in Down-Draft Boilers

By CHARLES A. FULLER.

Owing to the steadily advancing prices of anthracite coal there has come a demand for a boiler for low-pressure heating, which will burn the cheaper grades of coal, particularly in the large cities, where the heating of apartment houses and business buildings adds considerably to the expense of overhead charges, consequently cutting down the interest on the investment. This demand has been met by the comparatively large number of smokeless down-draft boilers, designed to burn bituminous coal.

The down-draft type, however, has its disadvantages. One of the chief objections to the standard type, when made without the magazine feature, is the constant attention required in firing, particularly in plants where a fireman is not employed constantly and where the boiler is fired by a janitor who may have many other duties. In large installations, where a fireman is employed all the time, this feature would not be objectionable.

When the boiler is left without attention for any great length of time the unevenness of the draft through the bed of coal causes the fire to become more intense in some portions than in others. This results in burning holes through the bed of coal on the upper grate, which, of course, reduces the efficiency of combustion. The intensity of the draft through these holes causes cinders to be drawn through and up the chimney. It is, therefore, necessary for the fireman to watch the condition of the fire on the upper grate and distribute the coal to avoid the formation of these holes.

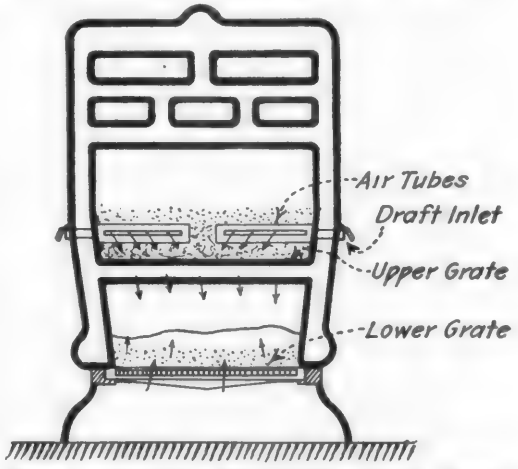


FIG. 2—BOILER EQUIPPED WITH SLOTTED AIR TUBES.

There has recently been developed a device which, in the writer's opinion, will practically eliminate this trouble. It consists of a slotted air tube placed across

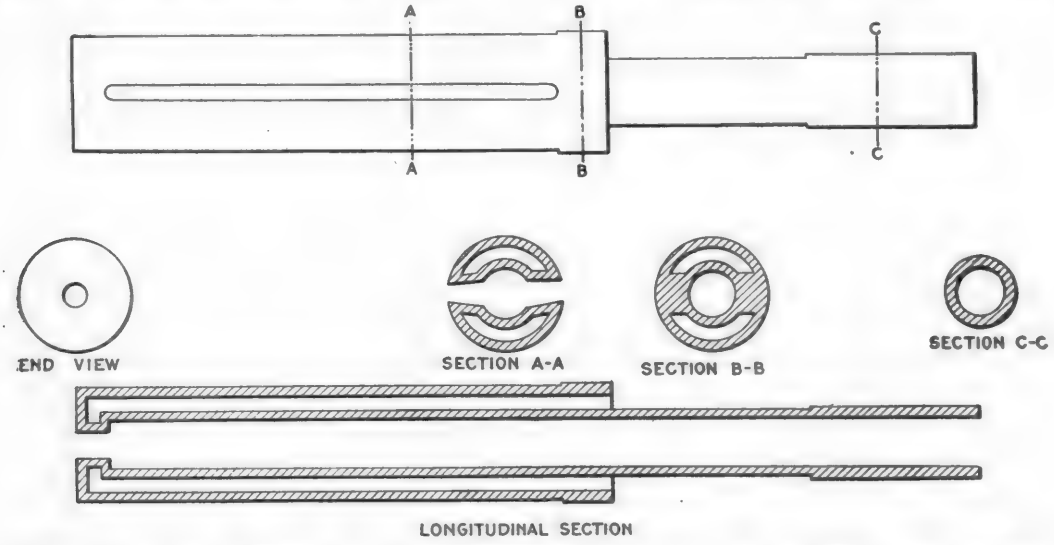


FIG. 1—CROSS SECTION AND LONGITUDINAL SECTION OF SLOTTED AIR TUBES FOR MAINTAINING EVEN COMBUSTION IN DOWN-DRAFT BOILERS.

the upper grate and about 6 in. above the top surface of the grate.

Fig. 1 shows a side view cross-section and longitudinal section through the tubes. The air enters from the side of the boiler, passing through the center opening and out into the bed of coal through the two openings on the side. The circular space between the air chamber and the outside is for a water jacket to prevent the burning of the tube.

Fig. 2 shows the application of the tube to the standard cast-iron sectional boiler. There are two tubes for each section, one inserted on each side with a space of about 6 in. between the ends of the tubes. The control of the draft is obtained by means of small check dampers, at the exposed ends, operating in unison.

In addition to providing an even distribution of air over the fire the tubes prevent the cold air from the outside coming in contact with the heating surface above the fire-box. The tubes also permit of a large quantity of coal being placed on the upper grates at one time without interfering in any way with either the draft or the efficiency of the combustion.

Things to Remember About Chimneys

BY E. C. MOLBY.

It is well know that the area, the height, and the construction of a chimney flue is of the greatest moment to the boiler manufacturer, the steam fitter and to the house owner.

In the construction of a chimney in connection with a power plant, the areas and construction of that chimney are very carefully figured out by the engineer to take care of the work that is to be placed on it.

In the construction of a chimney flue for a heating boiler, very little attention ordinarily is given to its suitability for the work in hand. The chimney has usually been assigned whatever space has been left after the arrangement of the rooms has been decided.

At the present time, however, there has been a great improvement on the construction of chimney flues for heating boilers, but generally flues are still constructed along the old lines that an 8-in. flue is big enough for any heating boiler, and wherever the flue has been put in with 8-in. tile, which is less than 7 in. square inside, in only a few instances has this area been sufficient to give proper combustion for the boiler placed on it.

It can be proved that there have been more boilers condemned on account of poor chimneys or poor draft than for any other reason. When the owner burned a paper in the bottom of the flue and because the flame went up the flue he has contended that his chimney was perfectly good and everything that could be desired. This does not prove the volume of the flue, only shows velocity, not capacity, and is in no sense a test of the flue or flue conditions.

A chimney flue should be of sufficient area and height to give to the boiler volume of air for the proper burning and combustion of your fuel, and should be constructed in each case according to the heating requirements. A high flue of small area is equal to a low flue of large diameter on account of its greater velocity.

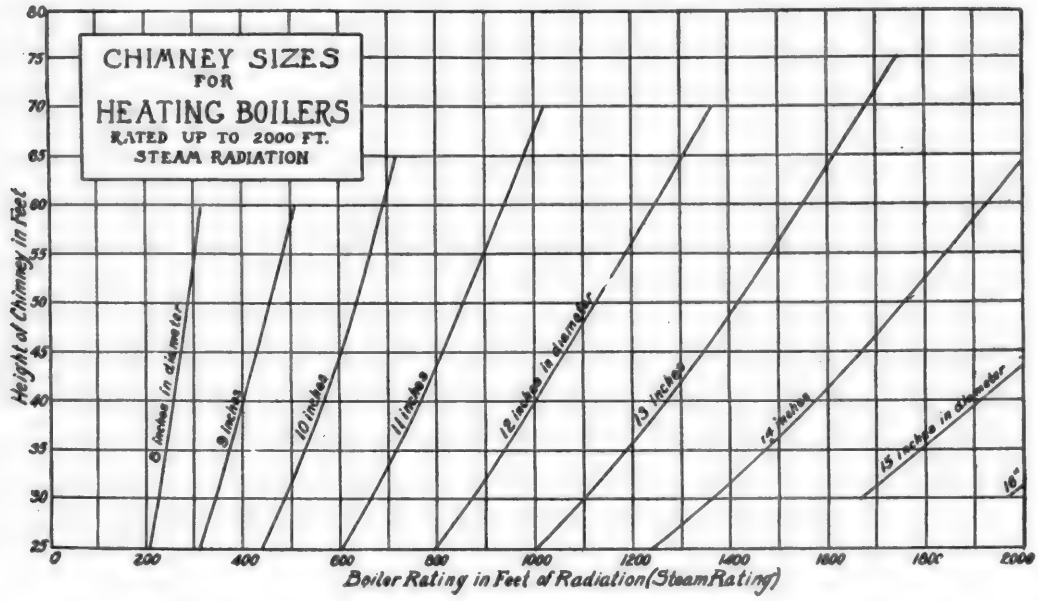
The flue should be round preferably, or square as a second choice, and should never be oblong except that it is of good proportion and not very narrow nor very long.

The flue should be straight, without offsets, and where tile lined, the joints should be carefully cemented, and the ordinary brick flue should be plastered or pointed smooth on the inside to close all openings and prevent leakage.

A separate flue should be built for each stove, fire place, or boiler, except that one flue can be used for a battery of boilers in which case tight fitting dampers should be placed in each smoke connection.

Two chimneys should not be connected at the bottom as is often done, but each flue should run separately and be distinct in all its parts from the bottom to the top.

The flue should be high enough above



its surroundings to avoid back drafts from currents of air over the roof or surrounding buildings, and in many cases trees covering too close over a chimney will affect its draft.

In the construction of flues, many times the builder will put two flues in one chimney and fail to grout in between the tiles so that the two flues are connected between the sections of tile from top to bottom. To avoid this there should be a partition between the tile flues, and the spaces around the tile grouted in with mortar.

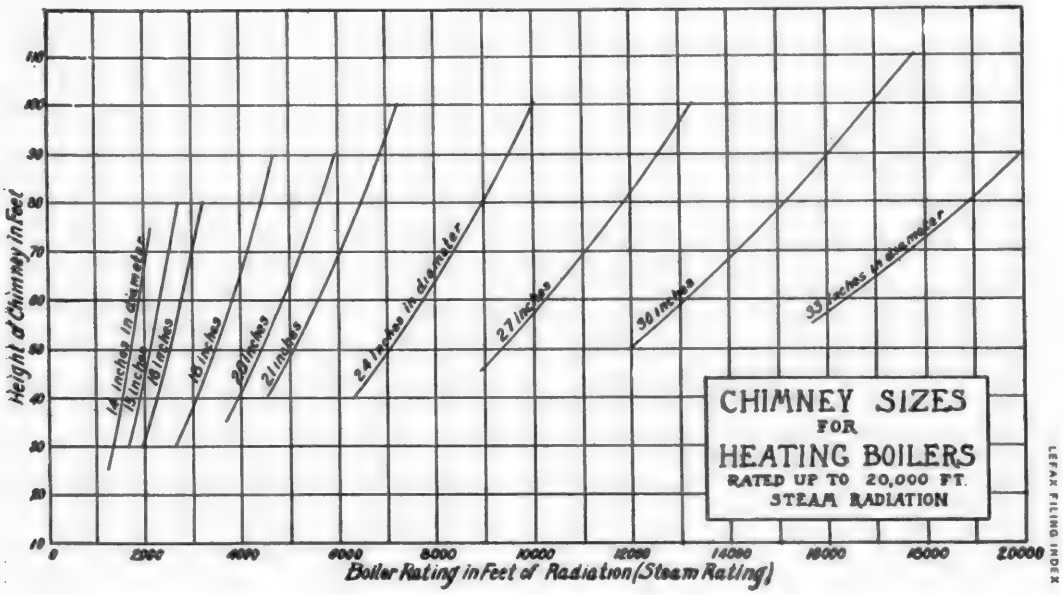
The flues should be so built that all of the air that passes into them passes through the boiler.

The smoke connection from boiler to chimney should be carefully cemented.

The clean-out door at the bottom of the flue should be tight.

In case of more than one flue in a chimney there should be no leakage from one to the other. Two flues should not enter into the same clean-out chamber.

A chimney flue should have straight sides, and not enter into some old fire place opening, but should be carried di-



LEFAX FILING INDEX

rectly through such opening and of the same dimensions as the flue above and below it.

In connection with the accompanying charts which were originally compiled by the H. B. Smith Company, Westfield, Mass., and published in Lefax, Philadelphia, for March, 1916, it should be borne in mind that with small sizes of coal for thick beds of fuel, taller chimneys are needed than with large sizes or for thin beds. Conversely, with tall chimneys, small sizes of coal should ordinarily be used.

In cases where the smoke pipe opening on the boiler is smaller than the chimney flue called for in the charts, it is desirable, especially with long smoke pipes, to bring the diameter of the smoke pipe or breeching up to within an inch or two of the diameter of the chimney, and to do this as close as possible to the smoke bonnet. The enlargement of the smoke pipe should be a gradual one.

When two or more boilers are connected to one chimney the sum of the ratings of all the boilers that may be in operation at one time should be used in determining the size of the chimney. The breeching should increase gradually in size as the individual smoke pipes enter it.

As the inside dimensions of brick flues and tile flue linings do not correspond to their so-called "commercial sizes," the accompanying table is given to show their actual inside cross-section area, together with the area of circular flues or smoke pipes.

BRICK FLUES, TILE FLUE LINING AND CIRCULAR FLUES.

Actual Inside Cross-Section Area of Commercial Sizes.

Brick Flue, Unlined, In.	Tile Flue Lining, In.	Circular Flue or Smoke Pipe, In. Diam.	Cross-Section Area, Sq. Ft.
.....	.....	8	50
.....	8½×8½	..	52
.....	.....	9	64
8×8	.....	..	72
.....	.....	10	78
.....	8½×13	..	80
.....	.....	11	95
8×12	.....	..	110
.....	.....	12	113
.....	13×13	..	126
.....	.....	13	133
.....	.....	14	154
12×12	13×18	..	169
.....	.....	15	177
.....	.....	16	201
12×16	.....	..	221
.....	.....	17	227
.....	18×18	..	240
.....	.....	18	254
.....	.....	19	283
16×16	.....	..	289
.....	.....	20	314
.....	.....	21	346
16×20	.....	..	365
.....	.....	22	380
.....	.....	23	415
20×20	.....	..	450
.....	.....	24	452
.....	.....	25	491
20×24	.....	26	530
.....	.....	27	572
.....	.....	28	616
24×24	.....	..	640
.....	.....	29	660
.....	.....	30	707
24×28	.....	..	750
.....	.....	31	755
.....	.....	32	804
.....	.....	33	855
28×28	.....	..	880

Smoke Prevention Codes for Large and Small Cities

Occasional requests from our readers for a model smoke ordinance that will serve for both large and small cities has brought out the information that such a code may be drawn up that will apply primarily to the small city, but which may be adapted, with slight modifications, to cities of any size.

The following typical ordinance, designed to meet the requirements of the small city, was drawn up by Osborn Monnett, of the American Radiator Company, formerly smoke inspector for the Chicago Smoke Inspection Department.

The ordinance as presented may be easily modified to the uses of a large city. In that case it would call for a chief assistant smoke inspector and several deputies, according to the size of the force that was desired to use.

With a larger staff of engineers the ordinance should also have a clause in-

corporating the requirement that installations be followed up for a test run made under operating conditions to decide whether or not the plant was satisfactory from the smoke standpoint. In the event that it was not, alterations should be made. After the plant was determined to be satisfactory, then a certificate of operation would be issued, fee for which would be included in the original permit fee.

Following is the model ordinance in full for a small city:

AN ORDINANCE PROVIDING FOR SMOKE INSPECTION AND ABATEMENT ESPECIALLY ADAPTED FOR A SMALL CITY.

AN ORDINANCE.

Providing for smoke inspection and abatement in the City of ————————.

Be it ordained by the City Council of the City of ———————— as follows:

SECTION 1. There is hereby created the office of smoke inspector, the compensation and duties connected therewith to be as hereinafter specified.

SECTION 2. The smoke inspector shall be appointed by the Mayor by and with the consent of the City Council, and shall perform the duties of his office until removed from office by the Mayor or until the Mayor by and with the consent of the City Council has appointed his successor.

SECTION 3. The person so appointed shall be an engineer, qualified by training and experience in the theory and practice of the construction and operation of steam boilers and furnaces and also in the theory and practice of smoke abatement and prevention.

SECTION 4. The salary of the smoke inspector shall be ———————— dollars ($) per annum.

SECTION 5. The said inspector is authorized to employ one clerk, to be selected from the civil service list of the city and the clerk shall attend to such duties as the inspector shall direct and be paid according to civil service rating in the manner fixed by law.

SECTION 6. The Mayor shall appoint a smoke abatement commission composed of three representative citizens, one of whom shall be a mechanical engineer of recognized standing, who shall act without remuneration as advisors to the Mayor and to the smoke inspector on matters pertaining to the organization or the conduct of the smoke abatement work, or both. The smoke inspector shall at all times receive and place on file all suggestions, recommendations, advice, or other communications that may be submitted to him in writing by the smoke abatement commission.

SECTION 7. No new plants or any reconstruction of any old plants for producing power and heat, or either of them, except for detached private residences, or for buildings used exclusively for private residence purposes, in which the number of families occupying apartments shall be less than six, shall be erected or maintained in the city until plans and specifications of the same have been filed in the office of and approved by the smoke inspector and a permit issued by him for such erection, reconstruction or maintenance. The plans and specifications to be filed with the smoke inspector shall show the amount of work and the amount of heating to be done by such plant and all appurtenances thereto, including all provisions made for the purpose of securing complete combustion of the fuel to be used, for the purpose of preventing smoke; said plans and specifications shall also contain a statement of the kind of fuel proposed to be used, including the commercial size of coal when such fuel is specified, and said plans and specifications shall also show that the room, apartment or basement in which such plant shall be located is provided with doors, windows, air shafts, fans and other means of ventilation sufficient to prevent the temperature of such room, apartment, basement or other portion of such building wherein such plant or apparatus is to be used, from rising to a point higher than 120 degrees Fahrenheit; and sufficient also to provide that the atmosphere of any such room, apartment or basement wherein such apparatus may be located, may be entirely renewed every ten minutes.

Upon the approval of such plans and specifications, a duplicate set of which shall be left on file in said office, and upon the payment of the fees hereinafter provided, the smoke inspector shall issue a permit for the construction, erection or maintenance of such plant. As soon as the smoke inspector has examined the plans and specifications submitted and has issued a permit as above provided, he shall then notify the Commissioner of Buildings to see that the execution of the work permitted is carried out in conformity with the plans and specifications, with special reference to the amount of space used, the size and construction of the chimney or chimneys used,

the provision for the prevention of smoke and the provision for ventilation, and the proper temperature in the room, apartment or basement.

SECTION 8. It shall be unlawful for any person to use any new or reconstructed plant for the production and generation of power and heat, or either of them, except for detached private residences or buildings used exclusively for private residence purposes in which the number of families occupying apartments shall be less than six, until he shall first have procured a statement from the smoke inspector that the plant is constructed in accordance with the plans and specifications filed with the smoke inspector at the time the permit was issued.

SECTION 9. No owner, lessee, or operator of any existing plant shall alter or repair any chimney or any old furnace or device, which alteration, change or installation shall affect the method or efficiency of preventing smoke, without first submitting plans and specifications to the smoke inspector and securing a permit therefor; however, that minor necessary or emergency repairs which do not change the capacity of such plant or which do not involve any substantial alteration in structure and which do not involve any alteration in the method or efficiency of smoke prevention may be made by or under the engineer in charge of said plant without a permit. Any person who shall violate sections 7, 8 or 9 shall be liable to a fine of $25.00 for each day upon which he shall prosecute such erection, construction, alteration, change or installation, or use any new or reconstructed plant without a permit, and each day's violation shall constitute a separate offense.

SECTION 10. The emission of dense smoke within the city from the smokestack of any locomotive, steamboat, or steam tug for a period of more than one minute, except for a period or periods aggregating not to exceed six minutes in any one hour during which period or periods the firebox or boxes are being cleaned or a new fire or fires are being built therein, is hereby declared a nuisance.

The emission of dense smoke within the city from the smokestack of any steam roller, steam derrick, steam pile driver, tar kettle or other machine or contrivance, or from the smokestack or chimney of any building or premises, or from any open bonfire, open bin, tank, vat, basin or other receptacle except for a period or periods aggregating not to exceed six minutes in any one hour during which period or periods the firebox or boxes are being cleaned or a new fire or fires are being built therein is hereby declared a nuisance.

Any nuisance such as the above specified may be summarily abated by the smoke inspector, or by anyone whom he may duly authorize for the purpose, and such abatement may be in addition to the fine hereinafter provided.

Any person or persons, or corporation owning, operating, or in charge or control of any locomotive, steamboat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle, or other similar machine or contrivance, or any open bonfire, open bin, tank, vat, basin or other receptacle, or of any building or premises, who shall cause or permit the emission of dense smoke within the city, in contravention of the provision of this section, from the smokestack of any locomotive, steamboat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle, or other similar machine or contrivance, or from any open bonfire, open bin, tank, vat, basin, or other receptacle, or from the smokestack or chimney of any building or premises so owned, controlled, or in charge of him, her, or them, shall be deemed guilty of a violation of the ordinance, and upon conviction thereof shall be fined not less than ten dollars ($10.00) nor no more than one hundred dollars ($100.00) for each offense; and each day of such emission of dense smoke shall constitute a separate offense.

For the purpose of grading the density of smoke, the Ringelmann smoke chart, as published and used by the Federal Bureau of Mines, shall be the standard of comparison. Smoke shall be considered "dense" when it is of equal or greater density than No. 3 of the chart.

SECTION 11. A fee of one dollar ($1) shall be charged for the inspection of plans and specifications for the erection, reconstruction, or alteration of any plant, this fee to include the issuing of a permit, in case such permit is granted.

The smoke inspector may and he is hereby directed and instructed to remit all inspection or examination fees charged, or that hereafter may be charged, against any and all charitable, religious, and educational institutions when the furnace or other device or apparatus inspected is located in or upon premises used and occupied exclusively by such charitable, religious, or educational institutions; provided, that such charitable, religious, or educational institution is not conducted or carried on for private gain or profit; and provided further, that the smoke inspector may require every application for the remission of such fees

to be verified by the affidavit of one or more taxpayers of the city.

SECTION 12. Prosecution for all violations of this ordinance shall be instituted by the smoke inspector and shall be prosecuted in the name of the City of _____.

The issuance and delivery by the smoke inspector of any permits for the construction or reconstruction, or any permit for the alteration or repair of any plant or chimney connected with a plant, or the exemption of any class of buildings from the necessity of taking out a permit, shall not be held to exempt any person or corporation to whom any such permit has been issued or delivered, or who has been exempt from such permit, from prosecution on account of the emission or issuance of dense smoke caused or permitted by any such person or corporation.

SECTION 13. Any person who shall violate any of the provisions of this ordinance (except as is herein otherwise provided) shall be fined not less than $25 nor more than $100 for each offense.

SECTION 14. The City shall provide such instruments, books, papers, and equipment as shall be necessary for the proper performance of the duties of the members of the department. The smoke inspector shall have charge of such instruments, books, papers and equipment as shall be necessary for the proper performance of the duties of the members of the department. The smoke inspector shall have charge of such instruments, books, papers and equipment, and shall deliver same to his successor in office.

SECTION 15. The smoke inspector shall cause to be kept in his office a complete record of all permits issued and of all examinations of plants made by members of the department and also of all certificates issued.

SECTION 16. The smoke inspector shall make a report of the work of his department to the Mayor and City Council, annually, on or before the first day of February, and at other times as often as required by the City Council.

SECTION 17. If any person on behalf of the City under the provisions of this chapter shall take or receive any money or any valuable thing for the purpose of favoring any person or persons, he shall be dismissed from the service.

SECTION 18. This ordinance shall take effect on and after its passage and publication.

Notes on the Rise of the Smokeless Boiler

The use of down-draft furnaces for power boilers for burning soft coal has been common for many years, and the type adopted by nearly all the heating boiler manufacturers is the Hawley down-draft furnace, with upper grate of water tubes for coking the coal, and lower grate for burning the coked fuel after the volatile products have been distilled. This method was used in Boston years ago for getting rid of smoke, and for burning cheaper soft coal, mainly for power purposes, in office building plants.

Naturally, it requires more draft to pass the air and gases through the two beds of fuel where the coal is so finely divided as is the case with a large portion of the soft coals. These furnaces were patented by Hawley, and good prices were paid as royalties for their use. As a rule they were fairly satisfactory where the fires were not forced, as if the coal was not properly coked on the upper grate or if there were holes in the fuel bed, there was likely to be smoke at the top of the stack.

Nearly every expedient was tried to overcome the smoke incident to the use of soft coal, but at first the possible economy in burning soft rather than hard coal was not thought of outside of the initial cost of the fuel. One scheme was to install steam pipes in front of the boilers with jets through which steam flowed when the doors were opened to replenish the fires. This scheme was fathered by two jewelers in Providence, who obtained control of such patents as existed. Where adopted the users were able to obtain immunity from the city fathers for the use of soft coal. The charge for the installation of the steam jets was $400 for a few feet of ¾-in. pipe, and a land office business was

done for some years in the sale of the device. It often happened, however, that the apparatus was shut off except when the smoke inspector put in an appearance, but immunity from censure was generally obtained when the steam pipes in the boiler front were exhibited.

Another efficient method used with horizontal tubular boilers was a grille of fire-brick in the back connection. This became very hot or incandescent, and served to consume the smoke as it passed to the flue.

HOW SOFT COAL MAY BE BURNED SMOKELESSLY ON FLAT GRATES.

As a matter of fact, soft coal can be fired without smoke in a regular flat grate, if the fireman is careful and is not required to force the fire. By shoveling the green coal at the front and allowing it to coke before being pushed back on the grate, the gases distilled from the green coal will be consumed by the fire at the rear. After the coal is coked, it is pushed back on the grate, and the operation repeated. In all these methods, however, forcing the fire will cause smoke.

SMOKING CHIMNEYS NOT NECESSARILY INEFFICIENT.

A great deal has been said and written about the loss and inefficiency of a smoking chimney. Judged from that standpoint alone, it must be admitted that the blackest smoke contains but a small percentage of the entire amount of fuel. Firemen will frequently state that they can make steam faster, and keep the pressure up better when the boiler flue smokes or when the smoke consumer is shut off, especially if he is using steam.

This is partly true, as when there is no smoke there is no radiant carbon in the gases, and the gases have to be brought in direct contact with the heating surfaces. The radiant particles of carbon give up their heat without being in such direct contact, which accounts for the firemen's statement.

On the other hand, when the furnace smokes the flues and passages become clogged with soot, insulating the boiler surfaces, and giving the firemen a highly unattractive job in cleaning the boiler.

There is no good reason why the down-draft furnace boilers should not be successful in reducing the high cost of living.

The main objection to the use of soft coal in a small installation is the coal itself, with its dust and dirt, and not the difficulty in burning it. In the case of larger buildings, where proper provision is made for the handling of the coal, this objection does not apply, and here lies, perhaps, the largest field of usefulness for the down-draft heating boiler.

Comparison of Various Methods of Figuring Duct and Flue Sizes

Standard Practice as Developed in Six Well-Known Engineering Offices.

By HAROLD L. ALT.

One of the most interesting subjects in heating and ventilation work involves the methods used to obtain the size of the flues and ducts for a given system to produce certain required results. In order to make a comparison of the various schemes used by recognized authorities the problem shown in Fig. 1 has been worked out by the various methods, the results shown and the amount of computation indicated.

For the purpose of demonstrating all the conditions usually encountered, the problem shown in Fig. 1 involves supplying 1,500 cu. ft. of air to each of 16 outlets, located as shown, from a fan placed at the left hand end. It is assumed that these outlets are in different rooms but that air requirements are the same—or, if the air is used for heating, that the heat requirements are identical.

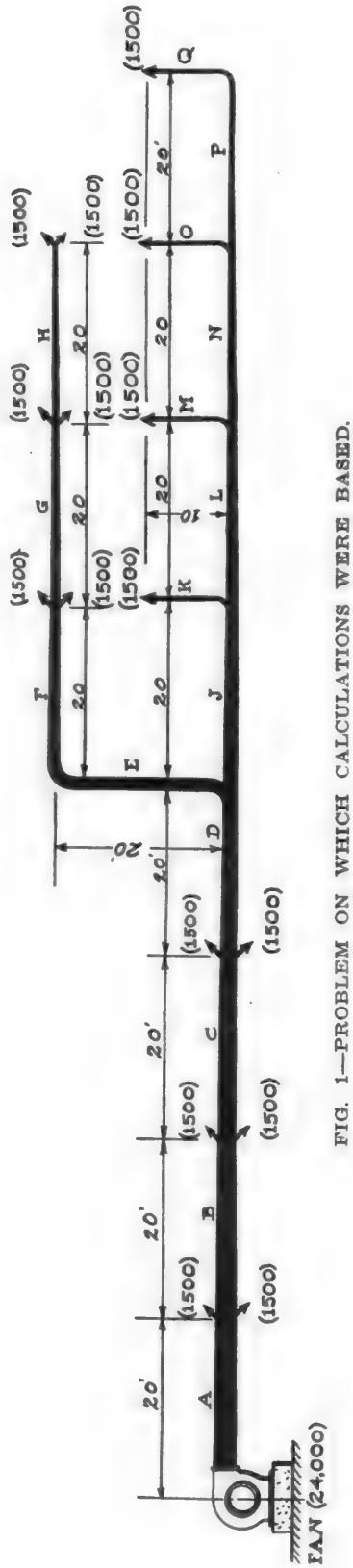


FIG. 1—PROBLEM ON WHICH CALCULATIONS WERE BASED.

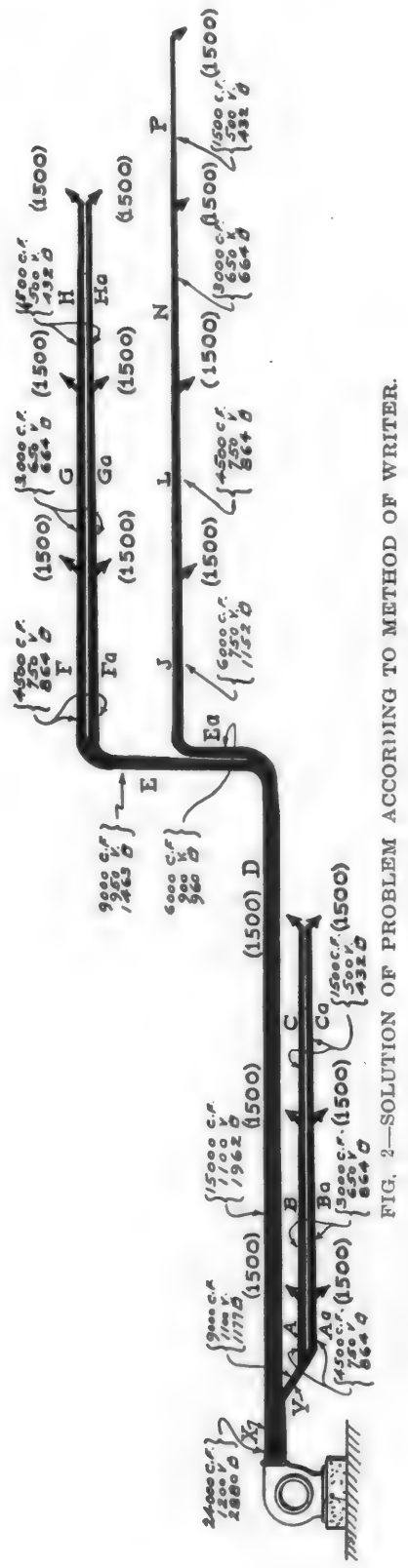


FIG. 2—SOLUTION OF PROBLEM ACCORDING TO METHOD OF WRITER.

METHOD USED BY THE WRITER.

The writer uses the following method: Assume velocities in the ducts ranging from 1,000 ft. per minute at the fan down to 500 ft. per minute in mains P and H. Size the ducts on the basis of the area required to pass the given quantity of air at the given velocity. Size flues on the basis of 400 ft. per minute velocity; size the registers on the basis of 250 ft. per minute velocity through the free area.

This gives a schedule of sizes as shown in Table 1.

TABLE 1—SOLUTION OF PROBLEM SHOWN IN FIG. 1, ACCORDING TO METHOD USED BY WRITER.

Duct or Flue	Length	Cubic Feet per Min.	Velocity Ft. Per Min.	Area, Sq. In.
A	Immaterial	24,000	1,000	3456
B	"	21,000	900	3360
C	"	18,000	850	3048
D	"	15,000	800	2700
E	"	9,000	600	2160
F	"	9,000	600	2160
G	"	6,000	500	1728
H	"	3,000	400	1080
J	"	6,000	750	1152
K	"	1,500	400	540
L	"	4,500	600	1080
M	"	1,500	400	540
N	"	3,000	500	864
O	"	1,500	400	540
P	"	1,500	400	540
Q	"	1,500	400	540

Registers equal 1500/250 or 6 sq. ft. net. This method is short, simple and in practice gives good results, the areas being as shown in Fig. 2.

METHOD NO. 2.

Another engineer would not use a trunk line at all unless all the outlets were in the same room. Where different rooms are supplied with air, different temperature requirements are encountered and this is thought to be best taken care of by the individual duct system. In this system a single separate duct is carried to each room (in this case, each outlet) and the air is supplied at the warmer or cooler temperature required. Automatic control operates mixing dampers in the hot and cold air chambers so as to give the desired temperature.

This method is illustrated diagrammatically in Fig. 3, the velocity in the flues being 400 ft. per minute and in the ducts being 850 to 900 ft. per minute; the ducts are made 8 in. wide by the depth required to give this velocity.

1500/850 = 1.76 sq. ft. × 144 = 253.44 sq. in. and this divided by 8 = 31+ in. depth. 30 in. is usually adopted.

Velocity through registers 300 ft. per minute through free area. This gives a schedule of ducts and flues as shown in Table 2.

TABLE 2—DUCT AND FLUE SIZES AS FIGURED BY METHOD NO. 2.

Ducts and Flues	Length	Cu. Ft. Per Min.	Velocity Ft. Per Min.	Area, Sq. In.
All ducts....	Immaterial	1500	900	240
All flues....	Immaterial	1500	400	540

Registers 1500/30 equals 5 sq ft. net.

U. S. GOVERNMENT METHOD.

The United States Government uses a method based on using the same velocity throughout the ducts, with modifications, reducing the velocity beyond the center of distribution and increasing it before the center is reached. This method consists of reducing the size of the fan outlet to an equivalent number of 1-in. pipes and dividing this equivalent number of 1-in. pipes by the amount of air handled per minute; this gives a decimal by means

TABLE 3—CALCULATIONS ACCORDING TO U. S. GOVERNMENT METHODS

Cubic Feet per Min.	Distance, ft.	Add for Turns, ft.	Equivalent Distance, ft.	Cubic Feet Times Lineal Feet
Two of 1500 ea.	20	—	20	60,000
Two of 1500 ea.	40	—	40	120,000
Two of 1500 ea.	60	—	60	180,000
1500	100	—	100	150,000
1500	120	—	120	180,000
1500	140	—	140	210,000
1500	160	—	160	240,000
Two of 1500	100	50 (a)	150	450,000
Two of 1500	120	50 (a)	170	510,000
Two of 1500	140	50 (a)	190	570,000
				2,670,000

(a) Assumed at 30 in. diameter and 10 diameters for throat radius equal to 1D.

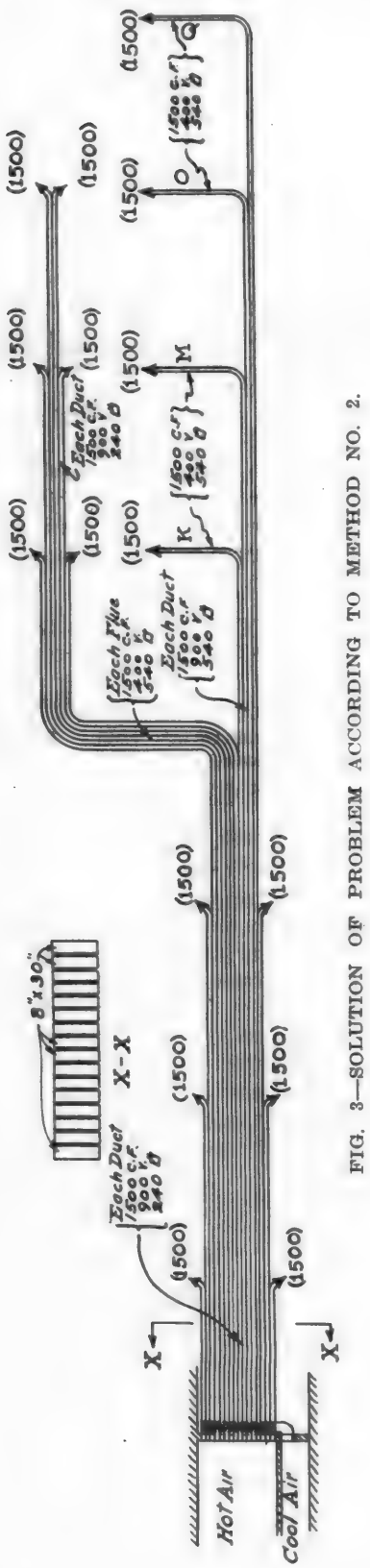


FIG. 3—SOLUTION OF PROBLEM ACCORDING TO METHOD NO. 2.

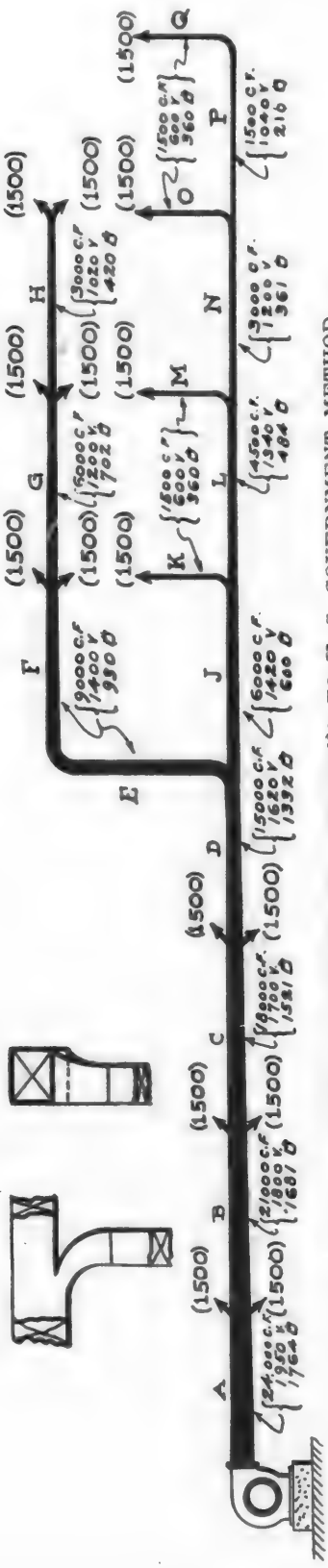


FIG. 4.—SOLUTION OF PROBLEM ACCORDING TO U. S. GOVERNMENT METHOD.

of which the area of any duct is obtained by multiplying the cubic feet of air per minute carried by this decimal. Then multiplying the cubic feet at each outlet by the distance back to the fan, adding the totals and dividing their sum by the total cubic feet of air per minute will give the number of feet to the center of distribution from the fan. One third of 1% is added for each foot beyond this center and 1/3 of 1% subtracted for each foot less than this center. The velocity in the vertical flues is 600, and 200 ft. per minute through gross area of register face.

Thus referring to Fig. 4 the outlets starting from the fan are as shown in Table 3.

$2{,}670{,}000 \div 24{,}000 = 111$ ft.

This is so near 110 ft. that 110 ft. may be taken for the sake of even figures. Then corrections on areas will be as shown in Table 4.

$$\text{C.F.M.} = 0.42\,D^3\,\frac{1430}{D} = 0.42\,D^2 \times 1430$$

$$= 600.60\,D^2 \text{ and } D^2 = \frac{\text{C.F.M.}}{600} \text{ or } \frac{24000}{600}$$

$40D^2$ and $D = \sqrt{40} = 6.3$, say 6-ft. wheel, or a 120-in. fan. A 6-ft. wheel at 4,500 ft. per min. tip velocity equals:

$6 \times 3.14 \times N = 4500.$

$18.84\,N = 4500.$

$N = 4500 \div 18.84 = 238$ R.P.M.

A 72-in. steel plate fan wheel has housing 57% of diameter of wheel, or $72 \times 0.57 = 41.04$ in., say, 42-in. housing and 42 in. x 42 in. outlet. Then the duct size at the fan will be 42 in. × 42 in., or equivalent to 11432 1-in. square pipes.

$11432 \div 24000 = 0.476$ factor.

In making branches the practice in this system is to make the branch the full height of the main, regardless of how narrow this makes the branch, put on the elbow, then transform into a circular or square duct as desired. This is illustrated in Fig. 4 by the detail of branch shown. The basis of computing the sizes of ducts and flues as shown in Fig. 4 is given in Fig. 5 and can be readily followed.

TABLE 4—CORRECTIONS ON AREAS.

Duct Supplying Outlet or Flue.	Center of Distribution, ft.	Outlet Distance, ft.	Feet.	Correction Factor.	Per-centage.
A	110	20	—90	0.0033	—0.30
B	110	40	—70	0.0033	—0.23
C	110	60	—50	0.0033	—0.17
D	110	80	—30	0.0033	—0.10
EF	110	150 (a)	+40	0.0033	+0.13
G	110	170 (a)	+60	0.0033	+0.20
H	110	190 (a)	+80	0.0033	+0.27
J	110	100	—10	0.0033	—0.03
L	110	120	+10	0.0033	+0.03
N	110	140	+30	0.0033	+0.10
P	110	160	+50	0.0033	+0.16

(a) 50 ft. added as equivalent for two 90° bends.

To get size of fan discharge and, therefore, the size of duct at the fan the size of fan must be first computed by the formula:

Cubic feet of air per minute $= AD^3N$.

$A = 0.42$ for air washer and ventilation fan.

C.F.M. = 24,000.

Tip speed of steel plate fan with air washer = 4,500.

Therefore $\frac{4500}{\pi D} = N$, or

$\frac{1430}{D} = N.$

METHOD USED BY NEW YORK DEPARTMENT OF EDUCATION.

In the New York schools still another method would be used. Here the outlets for any one section of a given floor are taken from a duct run horizontally on the ceiling of that floor, the duct being

Outlet at End Duct	Air for Outlet C.F.M.	Equiv. 1" Pipes at Factor .476	Correction %	Correction 1" Pipes	Total 1" Pipes for Outlet	Total 1" Pipes for Duct	Size of Duct	Area Sq. in.
A	3000	1428	-.30	-426	1002	11460	42"x42"	1764
B	3000	1428	-.23	-328	1100	10458	41"x41"	1681
C	3000	1428	-.17	-243	1185	9358	39"x39"	1521
D	No Out.	—	—	—	—	8173	36"x37"	1332
E	"	—	—	—	—	5140	30"x31"	930
F	3000	1428	+.13	+186	1614	5140	30"x31"	930
G	3000	1428	+.20	+285	1713	3526	26"x27"	702
H	3000	1428	+.27	+385	1813	1813	20"x21"	420
J	No Out.	—	—	—	—	3033	24"x25"	600
*K	1500	714	-.03	-21	693	—	—	360
L	No Out.	—	—	—	—	2340	22"x22"	484
*M	1500	714	+.03	+21	735	—	—	360
N	No Out.	—	—	—	—	1605	19"x19"	361
*O	1500	714	+.10	+71	785	—	—	360
P	No Out.	—	—	—	—	820	14"x15"	210
*Q	1500	714	+.15	+106	820	—	—	360
*Note...At 600 velocity or $\frac{1500}{600}$ = 2½ □" or..... .....360"								

FIG. 5—BASIS OF COMPUTING SIZES OF DUCTS AND FLUES ACCORDING TO U. S. GOVERNMENT METHOD.

supplied from a main vertical flue, the bottom of which is kept as close to the supply fan as the exigencies will permit. Between the fan and the flues a velocity of 1,000 to 1,200 ft. per minute is maintained and in the flues a velocity depending on the height of the flue. The ducts running along the ceilings of the upper floors are arbitrarily graduated from 375 at the farther end up to 750 near the supply flue. In order to supply the 16 outlets under consideration the duct and flue system would be rearranged as shown in Fig. 6 so that each floor would be supplied from a horizontal duct located on the ceiling of that particular floor.

The schedule used for sizing the ceiling ducts is shown in Table 5.

The vertical flues are assumed at velocities as follows:—

VERTICAL FLUES.

Story	Velocity Ft. per Min.
5	1100
4	1050
3	1000
2	950
1	900

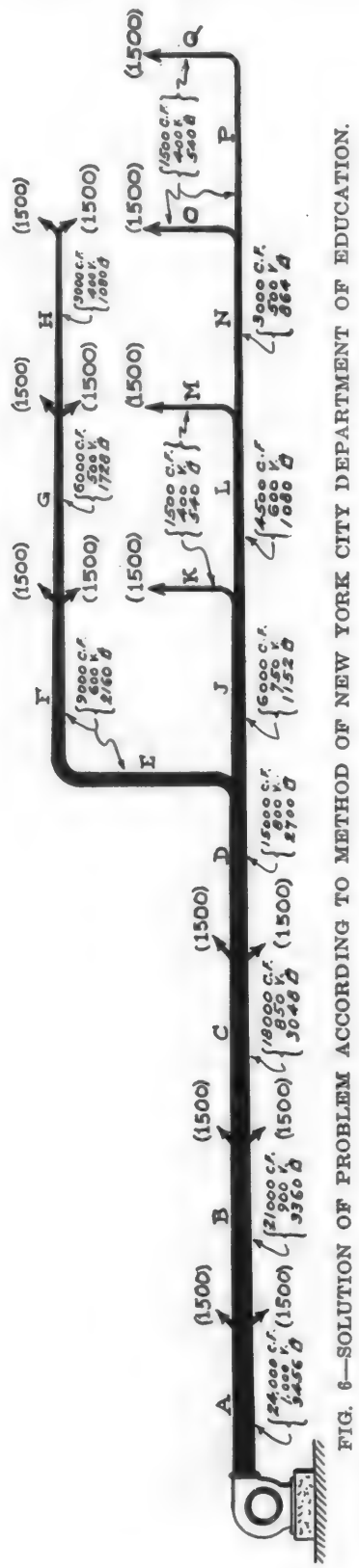


FIG. 6—SOLUTION OF PROBLEM ACCORDING TO METHOD OF NEW YORK CITY DEPARTMENT OF EDUCATION.

TABLE 5—SIZING CEILING DUCTS ACCORDING TO NEW YORK CITY DEPARTMENT OF EDUCATION METHOD.

Number of Rooms at 1,500 cu. ft. each.	Total Cubic Ft. per Min.	Horizontal Velocity Ft. per Min.	Area of Duct, Sq. In.
7½	11,250	750	2160
7	10,500	750	2016
6½	9,750	750	1872
6	9,000	750	1728
5½	8,250	750	1584
5	7,500	750	1440
4½	6,750	750	1296
4	6,000	750	1152
3½	5,250	750	1008
3	4,500	750	864
2½	3,750	700	771
2	3,000	650	664
1½	2,250	600	540
1	1,500	500	432
½	750	375	288

Registers at 250 ft. velocity over gross area.

This gives duct and flue sizes about as follows:—

TABLE 6—DUCT AND FLUE SIZES ACCORDING TO NEW YORK CITY DEPARTMENT OF EDUCATION METHOD.

Duct or Flue	Length	Cubic Ft. per Min.	Velocity Ft. per Min.	Area Sq. In.
X	Immaterial	24,000	1200	2880
Y	Immaterial	9,000	1100	1177
A	Immaterial	4,500	750	864
Aa	Immaterial	4,500	750	864
B	Immaterial	3,000	650	664
Ba	Immaterial	3,000	650	664
C	Immaterial	1,500	500	432
Ca	Immaterial	1,500	500	432
D	Immaterial	15,000	1100	1962
E	Immaterial	9,000	950	1463
Ea	Immaterial	6,000	900	960
F	Immaterial	4,500	750	864
Fa	Immaterial	4,500	750	864
G	Immaterial	3,000	650	664
Ga	Immaterial	3,000	650	664
H	Immaterial	1,500	500	432
Ha	Immaterial	1,500	500	432
J	Immaterial	6,000	750	1152
L	Immaterial	4,500	750	864
N	Immaterial	3,000	650	664
P	Immaterial	1,500	500	432

The registers are figured at 250 ft. per minute velocity over the gross area and as wire grilles are used this is practically 250 ft. per minute across the net area too. The reason for two ceiling ducts apparently paralleling each other is to prevent the open windows on one side the building blowing the air across the duct into the other side. In reality these two ducts consist of a single duct with a middle partition.

METHOD NO. 5.

A method used by another prominent engineer provides for temperature drop in the duct and then utilizes the equivalent number of 1-in. pipes in determining the duct areas. The amount of temperature drop is variable, depending upon the material used for the construction of the duct, its location, and its insulation. It is a very simple proposition to test the temperature drop for any length of run in an installation already working and to thus develop the number of feet of run for 1° drop in temperature. For convenience in calculating, it has been assumed in the following that there is 1° drop in every 20 ft. of run and the temperature at the fan is assumed as 120° F.; thus the air 20 ft. from fan would be 119° F., at 40 ft., 118°, etc.

The formula to obtain the quantity of air for any given B.T.U. loss per hour is:

$$\text{Cubic feet per minute equals } \frac{\text{B.T.U.}}{60\,(T\text{-}t)\,DS}$$

When B.T.U. = heat required in B.T.U. per hour.
T = temperature Fahrenheit of entering air.
t = temperature Fahrenheit of room air.
D = density of entering air at temperature T.
S = specific heat of air.
60 = number of minutes in an hour.

If the heat loss in each room is exactly equal to the heat brought in by the 1500 cu. ft. of air at 120° F., and 70° F. is the room temperature, the heating requirement is

$$\frac{1500\times(120-70)\times 60}{60} \text{ or } \frac{1500\times 50\times 60}{60}$$

$$=\frac{4500000}{60}=75000 \text{ B.T.U.}$$

60 being the number of cubic feet 1 B.T.U. will raise 1° at 120° (temperature T).
Then, by substituting, the C.F.M. (for any outlet where the B.T.U. loss is 75000 B.T.U.) will equal:

$$\frac{75000}{60\times(T\text{-}t)\times 0.0685\times 0.2375}$$

At 1° drop in temperature every 20 ft. the temperature at the outlets at the end of duct will be:

A = 119° F = 114° K = 114½°
B = 118° G = 113° M = 113½°
C = 117° H = 112° O = 112½°
Q = 111½°

$$A=\frac{75000}{60\times(119\text{-}70)\times 0.0685\times 0.2375}$$

The fall in temperature is so slight in any one system that to save computation

$$\frac{75000}{60\times 0.0685\times 0.2375}$$

may be reduced to a constant, which divided by (T-t) will equal C.F.M. This reduces to

$$\frac{75000}{0.976125} \text{ or } 76940$$

Then $A=\frac{76940}{119\text{-}70}\times 2$, or $\frac{76940}{49}\times 2$,
or $1570\times 2=3140$

$B=\frac{76940}{118\text{-}70}\times 2$, or $1603\times 2=3206$

$C=\frac{76940}{117\text{-}70}$ or $1637\times 2=3274$

$F=\frac{76940}{114\text{-}70}\times 2$, or $1748\times 2=3496$

$G=\frac{76940}{113\text{-}70}\times 2$, or $1789\times 2=3578$

$H=\frac{76940}{112\text{-}70}\times 2$, or $1832\times 2=3664$

$K=\frac{76940}{114\frac{1}{2}\text{-}70}=1729$

$M=\frac{76940}{113\frac{1}{2}\text{-}70}=1769$

$O=\frac{76940}{112\frac{1}{2}\text{-}70}=1810$

$Q=\frac{76940}{111\frac{1}{2}\text{-}70}=1854$

The total air to be delivered by the fan is the sum of these totals, or

A	3,140
B	3,206
C	3,274
F	3,496
G	3,578
H	3,664
K	1,729
M	1,769
O	1,810
Q	1,854
	27,520 C.F.M.

The same steel plate fan previously considered will deliver the required amount of air and, as previously noted, its outlet is 42 in. × 42 in. or equivalent to 11,432 1-in. pipes. Then the

$$\frac{11432}{27520}=0.415,$$

say 0.42, the number of 1-in. square pipes

to be allowed to each cubic foot of air per minute, this being called the factor (F). This factor, however, is usually made from 0.6 for shorter systems to 0.7 for longer systems to avoid excessive friction losses and high velocities. If 0.6 is used—

C.M.F.		F.		1-in. sq. pipes.
3140	×	0.6	=	1884
3206	×	0.6	=	1924
3274	×	0.6	=	1964
3496	×	0.6	=	2098
3578	×	0.6	=	2147
3664	×	0.6	=	2198
1729	×	0.6	=	1037
1769	×	0.6	=	1061
1810	×	0.6	=	1086
1854	×	0.6	=	1112

to the length of the duct system. The flues are designed for a constant velocity, but if flues are located near the fan, and space conditions demand, higher velocities are used. The highest allowable velocity of any flue near the fan depends upon the total pressure available for creating the flow of air. After the pressure available for the most unfavorable condition has been determined, the velocities are figured backwards and can thus be easily computed for any point desired.

Regardless of the exact velocities which may be used, any engineer can fix his own air flow speeds and the main point desired to bring out is that the ducts are sized on a *velocity* basis.

TABLE 7—DUCT SIZES, WITH ALLOWANCE FOR TEMPERATURE DROP, METHOD NO. 5.

H	= 2198 or 21 in. × 22 in.	= 462 sq. in. of duct
G	= 2198 + 2147 = 4345, or 28 in. × 29 in.	= 812 sq. in. of duct
E and F	= 4345 + 2098 = 6443, or 33 in. × 34 in.	= 1122 sq. in. of duct
P and Q	= 1112, or 17 in. × 17 in.	= 289 sq. in. of duct
O and N	= 1112 + 1086 = 2198, or 21 in. × 22 in.	= 462 sq. in. of duct
M and L	= 2198 + 1061 = 3259, or 25 in. × 26 in.	= 650 sq. in. of duct
K and J	= 3259 + 1037 = 4296, or 28 in. × 28 in.	= 784 sq. in. of duct
E and J	= 4296 + 6443 = 10739, or 40 in. × 41 in.	= 1640 sq. in. of duct
C	= 10739 + 1964 = 12703, or 44 in. × 44 in.	= 1936 sq. in. of duct
B	= 12703 + 1924 = 14627, or 46 in. × 46 in.	= 2116 sq. in. of duct
A	= 14627 + 1884 = 16511, or 49 in. × 49 in.	= 2401 sq. in. of duct

It can readily be seen that the proper quantity of air will be delivered to maintain the heat equilibrium and that the duct friction is kept at a fairly constant point, although not quite constant, as no allowance is made for bends, transformations, etc., and while the duct sizes thus obtained increase toward the far end of the system it is only because they are expected to handle a greater quantity of air at the same friction loss per foot of duct in order to compensate for temperature drop in the duct.

METHOD NO. 6.

Another engineering firm uses a velocity method in which the velocities at the end of the lines vary from a proportion of 30 per cent. to 60 per cent., according

There are doubtless other methods of proportioning sizes, but it is felt that bringing these few important systems to the notice of the reader has opened up a profitable avenue of thought. The variety of paths, all of which lead to Rome, and lead *successfully,* makes it a question if the more laborious calculations (while perhaps more nearly theoretically correct) are not somewhat of a waste of time in practical work. Not one of the systems (no matter what formula it may be sized from) will give correct or even approximately correct results without the use of volume dampers, and, therefore, of what use is too much refinement? Is not the simplest, easiest and quickest way more economical in the engineer's time and equally satisfactory?

THE HEATING AND VENTILATING MAGAZINE

A Monthly Journal of Engineering Progress

Vol. 13 October, 1916 No. 10

PUBLISHED MONTHLY BY THE
Heating and Ventilating Magazine Co.
1123 BROADWAY, NEW YORK

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Subscription	$1.00 per year
Canada	1.25 " "
Foreign countries	1.50 " "
Back numbers	15 cents each
Back Nos. prior to current year.	25 cents each

IN PRESENTING this issue as a "Smokeless Boiler Number" a correspondent reminds us that, speaking technically, there is no such thing as a smokeless boiler. In other words, the boilers themselves have nothing to do with making smoke. At all times it is the furnace. For that reason the careful manufacturer, in his printed matter, simply refers to smokeless furnaces. In a typical catalogue, for instance, a boiler with smokeless furnace is shown facing the same type of boiler without smokeless furnace.

It is well to bear this distinction in mind, but, at the same time, it is highly desirable to have a short, but comprehensive, designation for boilers intended to be smoke-consuming, and until this is supplied, it is hard to think of a more easily understood term than "smokeless boiler."

IT GOES without saying that the average householder, in the East, at any rate, knows little about the movement for smokeless combustion. He has always burned hard coal and has never had to give the matter any thought. This is true, almost to the same extent, in the case of heating contractors throughout the East. For that reason the general run of heating contractors has been more than shy in adopting the new types of heaters, and contractors have uniformly refused to guarantee them from the standpoint of smokeless operation.

We venture to state, however, that no unbiased reader can study the articles presented in this issue without realizing, first, that the smokeless combustion of coal is a logical and proper development in the heating industry and, second, that the increasing number of manufacturers who are adding "smokeless" boilers to their lines is proof in itself of the importance and success of the movement. In short, it is obvious that the "smokeless" boiler has come to stay, and we feel that we are doing a very real service in awakening the general trade to the situation that confronts it in this connection, as well as to its opportunities in promoting this comparatively new and important phase of the heating art.

OCTOBER sees a renewal of the activities of the engineering societies and, in the case of the heating engineers, the existence of local organizations (some of them newly formed), with headquarters in New York, Boston, Philadelphia, Cleveland, Detroit and Chicago, promises a season of more than usual interest. Between the compilation of codes of ethics, the work of educational committees and co-operation with ventilation commissions, there is a call to everyone connected with the profession in the localities named to get together and accomplish some constructive work this year. In the language of the day, "this means you."

THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

65—The Economy of Superheated Steam.

QUESTION: What is the difference between saturated steam and superheated steam, and why is the latter more economical for power?

ANSWER: The difference is purely one of physical condition. Every steam pressure has a corresponding fixed temperature in the case of saturated steam and this condition obtains, when the steam and water are in contact in the same vessel or reservoir.

Before water becomes steam, the latent heat has to be added, amounting to a varying quantity from 762 B. T. U. per pound of steam, at 500 lbs. pressure, to 1034.6 B. T. U. per pound at 1 lb. pressure absolute. This latent heat has to be provided for each pound of steam used for power, although it cannot be utilized. This explains the reason for the economy in the use of exhaust steam for heating.

Since the sensible heat or visible temperature of steam increases with the pressure and the latent heat decreases, the total heat supplied, to produce any pressure and temperature, is nearly the same per pound, or there is a variation of only 1200 B. T. U. per pound at 500 lbs. pressure to 1100 B. T. U. per pound at 1 lb. pressure absolute.

Therefore, raising the initial pressure on a boiler does not increase the fuel expense appreciably, except for the losses in radiation due to the higher temperatures. Superheated steam is a condition obtained by adding heat to the steam when not in contact with the liquid, and the temperature raise is approximately 2 degrees for each B. T. U. added per pound of gas.

The use of superheated steam is more economical, but the impression is frequently conveyed that the economy is due largely to the peculiar features of the particular type of engine or turbine under consideration. This may be true to a slight extent, but the economy, as will be shown, is mainly due to the condition of the steam. That is, if superheated steam were used on any engine at the same pressure as saturated steam, regardless of the type, some saving would be shown, although this would be increased somewhat if the engine were especially adapted for the use of superheated steam.

The statement has often been made that the only advantage in the use of superheated steam, when used on a reciprocating engine, is in the reduction of cylinder condensation due to radiation of the heat and the reheating of the cylinder walls with the varying pressures and temperatures, as the steam is expanded in doing work. This is also true, to a certain extent, as when heat is lost by radiation from the cylinder walls in the case of saturated steam, a certain percentage of water is formed, reducing the volume of gas at the rate of approximately 400 units of volume for each unit of volume of water produced, say, at 50 lbs. pressure.

In the case of superheated steam, there is no water produced and the volume only changes slightly for the loss of heat, no water being formed. Of course, the above assumes working conditions as would be obtained in practice.

If sufficient heat were extracted, the superheat would be lost, and if further radiation occurs, water would be produced the same as if the steam were saturated, only not to the same extent.

For each unit of weight condensed, the latent heat at approximately 1000 B. T. U. per pound, has to be radiated, so the quantity of water would be comparatively small in most cases and could easily be eliminated entirely by the use of superheated steam. When water is once formed, it takes the same amount of heat to re-evaporate it, and as the specific heat of steam is approximately one-half that of water, the presence of the latter in the cylinder causes uneconomical operation. In the generation of steam, the big item is the latent heat which is about seven times the actual heat capable of being utilized for power, before it is exhausted to the atmosphere or condenser.

The minimum weight of fluid or water used to produce steam at any pressure will prove more economical as requiring less latent heat. If we assume a pressure of

190 lbs. absolute, of which we require a certain number of cubic feet per unit of time, the difference in heat to produce a cubic foot of steam at saturation and at 200 degrees super-heat will be as follows:

190 lbs. pressure, absolute—	T'l heat above 32 deg. F, B. T. U.	Temperature, Deg. F.	Cu. ft. per lb.
Saturated steam...	1197.3	377.6	2.41
Superheated steam, 200° F.....	1306.3	577.6	3.19

The total heat includes that required to raise the water from 32° F. to 377°, and the latent heat at 190 lbs., or 846.9 B. T. U. per pound.

We will assume the water taken at an initial temperature of 210°, as this feed water temperature is generally obtained from waste gases or exhaust steam, and determine the quantity of heat required to produce a cubic foot of steam under each condition named, as one will operate as well as the other to produce power after steam is generated.

The heat required to raise the feed water from 32° to 212° will be 180 B. T. U. per pound, and the heat required per pound for each condition will be as follows:

Saturated steam: 1197.3 — 180 = 1017.3, B. T. U. per pound.

Superheated steam: 1306.3 — 180 = 1126.3 B. T. U. per pound.

In the first case, if we obtain 2.41 cu. ft. from each pound of liquid, we have the heat per cu. ft. to be supplied.

1017.3 ÷ 2.41 = 422.1 B. T. U. per cu. ft.

In the second case we obtain 3.19 cu. ft. from each pound.

1126.3 ÷ 3.19 = 353.1 B. T. U. as the heat required to produce, at 190 lbs. pressure, 1 cu. ft.

This would show a saving in steam generated of:

422.1 ÷ 353.1 = 1.196, or a saving of almost 20% in the use of superheated steam before it enters the engine. There are also the advantages of overcoming the radiation of machinery parts and piping, without obtaining water due to condensation.

It is readily seen that the economy is due to the increase in the volume due to superheating and to the fact that the latent heat is a constant quantity and a large proportion of the total amount in both cases. The economy is really independent of the type of engine, although, as stated, some types are better adapted to its use than others.

The expense of installation and up-keep, however, is very great when superheated steam at high temperature is used, as the piping fittings and valves have to be made of special steel as well as the engine and its valves.

The foregoing is not especially a plea for the use of superheated steam, but merely to show that the economy lies in the physical characteristics of the steam, rather than in the type of engine.

LEGAL DECISIONS

Discriminative Taxation of Heating Co.

When there are two or more public service corporations engaged in furnishing heat, light and power to the people of a city and occupying the streets, alleys and public places of the city with their apparatus for that purpose under franchise granted by the city, the fact that one furnishes heat, light and power by electric current conveyed by wires and the other by gas conveyed by underground mains does not furnish a sufficient basis for classification to justify an occupation tax upon one of the companies and not upon the other. A tax so levied is void for unjust discrimination.—City of Lincoln vs, Lincoln Gas & Electric Co., Nebraska Supreme Court, 158 N. W. 962.

Heating Radiation as "Fixtures."

The Michigan Supreme Court holds that heating radiation upon several floors of a five-story business building, which had been installed by a tenant and was capable of removal from the premises, was not part of the realty which would pass by the landlord's lease, but constituent fixtures belonging to the former tenant. The term "fixtures" in connection with such a building means such chattels as merchants usually possess and annex to the premises occupied by them, to enable them the better to store, handle and display their goods and wares. They are generally removed without material injury to the premises.—Lovett vs. Birmingham-Seaman-Patrick Co., 158 N. W. 883.

Damages for Owner's Breach of Installation Contract.

Action was brought for damages for breach of contract whereby the defendant engaged the plaintiff to install a heat and water plant in the defendant's residence. The plaintiff shipped the necessary materials and supplies to the railway station nearest the defendant's residence, but the defendant refused to permit the plant to

be installed, alleging the contract had been procured by fraud. The plaintiff installed the plant for another at a sum much less than that the defendant agreed to pay him, and claimed the difference as damages. He offered no proof of the value to him of the contract with the defendant, had it been fulfilled. On appeal from a judgment for the plaintiff, the North Dakota Supreme Court held that the plaintiff was entitled to the benefit of his bargain, nothing more, and in order to recover he must establish what, if anything, such bargain was worth to him. It was therefore incumbent upon him to prove what sum the labor and materials necessary for the installation of the plant would reasonably cost him at or about the time the plant was to be installed, and his damage would be the excess, if any, of the contract price above such sum.—Turner vs. Affedt, 158 N. W. 263.

Time for Filing Mechanic's Lien.

In an action to foreclose a mechanic's lien for a balance due for installing a heating plant in the defendant's residence, it appeared that the plaintiff, with the consent of the defendant, removed part of the boiler and replaced it because the plant was unsatisfactory. The Indiana Appellate Court held that the removal and repair would be deemed the lost work done by the contractor, and notice of lien filed within 60 days thereafter would entitle him to a lien.

Heating and Ventilating Employee Sues General Contractors.

In an action for damages for personal injuries by an employee of heating and ventilating contractors against general contractors, it appeared that the defendants had a contract with a school board to erect a school building complete save a heating and ventilating system. The company for whom the plaintiff was working had a contract with the school board for installing that system. The defendants and the plaintiff's employers were each at the same time carrying out their respective contracts with the school board. The defendants, under their contract, were to furnish and install joists in the attic of the building, upon which a tank that was to be a part of the heating and ventilating system was to be placed by the plaintiff. The defendants knew that this was one of the purposes for which the joists were to be used. After the defendants had selected and installed the said joists, but before they had fully completed their contract and turned the building over to the school board, the plaintiff in installing the tank went upon the joists, one of which broke, as a result of which he fell and was injured. The Oklahoma Supreme Court holds that if the defendants knew, or by the exercise of ordinary care could have known, that the plaintiff might be reasonably expected to go upon the joists in installing the tank, the defendants owed the plaintiff the duty to exercise ordinary care in the selection of the joists, although the relation of master and servant did not exist. Judgment for the plaintiff was affirmed.—Lisle vs. Anderson, 159 Pac. 278.

Is Washed Recirculated Air Better Than Fresh Air?

A note published in last month's issue referred to the recent tests with washed and partly recirculated air, and with fresh outdoor air, in one of the Bronx, New York, schools and quotations were given from the report on the tests, signed by E. L. Thorndike, G. J. Ruger, and W. A. McCall. According to this report, as good progress was made by children subjected to partly recirculated air as by those provided with a liberal supply of outside air. The rate of improvement recorded by both groups was decisive, but the advantage was found to be with the children supplied with washed, recirculated air. The tests given the children did not include health tests, but had to do with progress in their studies and other tasks.

In discussing this report a correspondent has called attention to the danger of their being misinterpreted by those who do not thoroughly understand the details of the test.

"Very serious and irreparable harm is likely to result," he states, "from such reports if school authorities are led thereby to install purely recirculating systems of ventilation, as they are almost always certain to prove injurious to health. As a matter of fact the tests so far made by the New York State Commission on Ventilation have been so unsatisfactory, and so lacking in conclusive evidence that the commission has until now refrained from promulgating any official statement of its findings.

"The reason for this is that the only 'indicators' available for use in such tests are so delicate that the errors of observation are almost as great as the observable variations due to test conditions, especially as the human body accommodates itself remarkably well to ordinary variations in climatic conditions, and also because the

effects of conditions under which the pupils live at home and elsewhere, outside of school hours, are quite as liable to affect the test findings, as are the conditions under which the tests are being made.

"Moreover, in the tests in question, the pupils, it should be remembered, were not subjected continuously to recirculated room air with no admixture of fresh air. From the percentage of CO_2 noted in these tests, it is evident that the so-called recirculated air in the tests referred to was very largely fresh air entering the room through window and wall leakages, etc. Not attempt was made, apparently, to prevent the usual and very considerable infiltration of air.

"Another point in connection with these tests is that the problem was treated from one side only, that of increase in learning, totally ignoring the possible dangers to health involved.

"Even if recirculated air is washed, it is very doubtful if all disease germs are eliminated thereby, and in the absence of exact knowledge as to what transmits such diseases as infantile paralysis, it surely behooves heating engineers and sanitarians to avoid all possible causes of the spread of this disease.

"Moreover, it is absolutely unsafe to trust to janitors to exercise discretion as to the proper amount of fresh air which should be added to the recirculated air, or to see that such proper admixture is always obtained.

"There are, of course, many eminent authorities who are willing to claim that air cannot spread diseases, but it is better to be safe than sorry, and the saving in coal to be effected by the partial use of recirculated air, in the writer's judgment, should not be considered in view of the doubt as to the dangers to health possibly caused thereby."

Current Heating and Ventilating Literature.

(Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.)*

CENTRAL STATIONS—

Central-Station Heating Plant Operation in Milwaukee. O. M. Rau. Ills. 2500 w. El W—July 29, 1916. Electrical energy produced as by-product of heating plant. 20c.

Central Station Steam Heating by Miles City, Montana, Municipal Plant. G. C. Pruett. 3000 w. Mun E—July, 1916. Successful plant. 40c.

HEAT TRANSMISSION—

Effect of Velocity and Humidity of Air on Heat Transmission Through Building Materials. J. A. Moyer, with discussion. (Abstract.) 8 pp. A S R E—July, 1916. Discussion of tests made at Penn State College. 60c.

HOT-WATER SYSTEMS—

Hot Water Heating Systems. William Schultheis. 1000 w. N E—July, 1916. Tables and calculations. 20c.

POWDERED COAL—

Powdered Coal Burning. Ills. 800 w. I A—July 20, 1916. Plant at Middletown, Pa. 40c.

STEAM TRAPS—

Kinds and Uses of Steam Traps. Ills. 2000 w. Pwr—July 11, 1916. Characteristics of various classes. 20c.

CORRESPONDENCE

Data on the Capacity of Heated Air to Carry Moisture.

Editor HEATING AND VENTILATING MAGAZINE:

Referring to the correspondence published in your August and September issues regarding the capacity of heated air to carry moisture, it does not seem to the writer that you have proved your point or succeeded in controverting the statement made by Kent. The writer of your reply is evidently biased towards blowers for drying purposes.

Our company has had a wide experience with all kinds of drying equipment, and in connection with our observation of blowers, we have found that they invariably fail to get proper humidity for efficient drying. We are vitally interested in this subject because the question is coming up every day in the operation of drying equipment.

It would seem to us rather strange if there is not some recognition in standard text-books or hand-books of the fact that high humidities, in rapidly-moving blast systems of drying, are difficult, if not impossible to maintain.

In further reply to our correspondent we take pleasure in presenting herewith the following discussion of the subject contributed, on request, by Professor William Kent:

"Referring to the correspondence on

'Capacity of Fans to Carry Saturated Air,' on page 51 of your August issue, and to the statement quoted from my 'Mechanical Engineers' Pocketbook' that 'as a carrier of moisture hot air cannot in practice be charged half its full saturation, and it is in fact considered a satisfactory result if even this proportion be attained,' this statement is quoted from Mr. Emil Passburg's paper in Prac. Inst. Mech. Eng. for 1889, and Mr. Passburg is good authority. As far as I know, the statement is strictly correct, if emphasis is put on the words 'in practice.' No doubt, theoretically, nearly complete saturation might be obtained if the apparatus were run slowly enough to give the air plenty of time to become saturated before leaving, and if it could be insured that there would be no short-circuiting or stratification of the air in its passage through the material, and if the temperature of the air admitted were high enough to cause it to carry in enough heat to effect the evaporation of the water.

"In the later editions of my Pocketbook, I have given much more matter on the subject of drying, but nothing in contradiction of Mr. Passburg's statement.

"Consider an ideal case of a sand dryer, a vertical clyinder 1 ft. in diameter, with a hopper at the top to receive the wet sand, open at the bottom to allow the sand to flow into a box beneath, and in the cylinder a screw conveyor slowly revolving to keep the sand from clogging or scaffolding as it flows downward. Hot air is blown in through a ring of holes near the bottom. Assume that the hopper receives 100 lbs. of sand per minute (weighed in the dry state), and 20 lbs. of water. Suppose that the air has been dried by passing it through a refrigerator, and is then heated to 200° F. before passing into the bottom of the dryer. 1 lb. of air heated to 200° F. has a capacity of absorbing 2.3 lbs. of water, but as it cools in traveling upward through the moist material we are not concerned with its total capacity when at its hottest, but only with

TABLE SHOWING RELATIONS OF TEMPERATURE AND AMOUNT OF AIR REQUIRED FOR DRYING.

Temperature of entering air and of dry sand, deg. F.	200			300	
Temperature of escaping air and moisture, deg. F.	80	100	120	100	120
Total heat above 60° F. of 1 lb. escaping air, B. T. U.	4.8	9.6	14.4	9.6	14.4
Total heat above 60° F. of 1 lb. escaping moisture, B. T. U.	1,067	1,076	1,085	1,076	1,085
Total heat above 60° F. of 100 lbs. dry sand, B. T. U.	2,800	2,800	2,800	4,800	4,800
B. T. U. for evaporating 20 lbs. water	21,340	21,520	21,700	21,520	21,700
B. T. U. for evaporating water and heating sand	24,140	24,320	24,500	26,320	26,500
B. T. U. in 1 lb. entering air, less B. T. U. in escaping air	28.8	24.0	19.2	48	43.2
Pounds air required to furnish total heat	838	1,013	1,276	548	613
Pounds moisture in 1 lb. escaping air, saturated	0.02226	0.04305	0.0813	0.04305	0.0813
Pounds saturated air carrying 20 lbs. water	898	465	246	465	246
B. T. U. in this air for evaporating water and heating sand	25,863	11,160	4,723	22,320	10,617
Excess B. T. U. over that required	1,723	.....	.....	.....	.....
Deficiency in B. T. U. over that required	.....	13,160	19,777	4,000	15,883
Relative humidity in escaping air, per cent.	100	45.9	19.3	84.9	40.1

the capacity when it escapes from the cylinder.

"Suppose it escapes at 100° F. Then each pound of air will carry, when fully saturated, only 0.043 lbs. of moisture, or, if 50 per cent. saturated, only 0.0215 lbs. In order to carry away the 20 lbs. of water from the 100 lbs. of sand per minute, the amount of air required per minute, if fully saturated when it leaves, would be $20 \div 0.043 = 465$ lbs., or at 13 cu. ft. per pound (measured at 50° F.), 6045 cu. ft. If the air on leaving were only half saturated, twice this amount would be required.

"Now how much air would actually be required in practice? A calculation on the heat unit basis may furnish at least an approximate answer. If the wet sand is introduced at 60° F., and the moisture leaves at 100° F., each pound of moisture must have supplied to it $(100 - 60) +$ latent heat $1036 = 1076$ B. T. U., or 21,520 B. T. U. for the 20 lbs. of water in the sand. If the sand left the dryer at 200° F., it would carry away (above 60°) $100 \times (200 - 60) \times$ specific heat $0.20 = 2800$ B. T. U.

"Each pound of air at 200° carries in $(200 - 60) \times$ specific heat $0.24 = 33.6$ B. T. U. (measured above 60° F.), and takes away, at 100° $(100 - 60) \times 0.24 = 9.6$ B. T. U., leaving 24 B. T. U. available per pound of air for evaporating the water in the sand. Dividing $21,520 + 2800$ by 24 gives 1,013 lbs. as the amount of air needed for evaporating the water and heating the sand. As only 465 lbs. of air would be required if the air were saturated, the degree of saturation of the 1,013 lbs., when escaping, would be $465 \div 10.13$, or 45.9 per cent.

"This calculation takes no account of loss of heat by radiation or other possible losses.

"I have made five calculations whose results appear in the accompanying table, which show that the degree of saturation of the escaping air depends on the temperature both of the escaping and entering air, and that the amount of air required for drying depends also on both of these temperatures."

FURTHER DISCUSSION BY F. R. STILL.

There seems to be a misunderstanding between your correspondent, Professor Kent, and the writer in this discussion which appears to be due to the fact that there has not been submitted a concrete example on which to work. The hypothetical case submitted by Professor Kent does not seem to the writer to conform to the problem as it was originally stated.

If your correspondent will present a case covering his question in detail wherein all the points, which vary in every dryer problem, are clearly and definitely set forth, so that calculations can be made better than in the abstract, then very likely correct and definite replies could be given.

The writer sees no reason for changing his conclusions as previously expressed in your columns because of the further statements made by your correspondent or the problem submitted by Professor Kent, as the two harmonize.

Reviewing again the writer's statements in your last issue, one cubic foot of air at 50° F. outside temperature, and which is 50 per cent. saturated (this being average temperature and humidity conditions througout the year) will carry 2.12 grains of moisture. Heating this 1 cu. ft. of air to 200° will increase its olume to approximately 1.293 cu. ft., but it still contains only the same 2.12 grains of moisture it had originally.

Now if this air at 200° temperature comes in contact with a wet substance, which latter is properly arranged inside of a chamber for that purpose, and the moisture can be readily evaporated from the substance when so arranged, and the air is circulated at just the right velocity so that it is finally reduced to the lowest possible temperature without precipitation before it escapes from the compartment wherein the drying operation is taking place, the air could only be lowered to 84° when it would become completely saturated, and anything below this temperature would cause precipitation. It will then carry about 12.3 grains of moisture or it has absorbed 10.18 grains in addition to what it originally carried.

Now again, if this air were allowed to escape at 100°, it would only carry 10.7 grains, or it will have absorbed about 8.52 grains, which is only about 84 per cent. of the amount it would have absorbed if allowed more time so that it could be cooled down to 84°, and it would be about 54 per cent. saturated instead of 100 per cent. as before.

Again suppose the air were allowed to escape at 120°, it would only carry about 8½ grains or it will have absorbed 6.32 grains, which is about 62 per cent. of the amount absorbed in the first instance, and would only be about 24½ per cent. saturated.

All the foregoing presupposes that there are no losses by heat radiation from the dryer; no air leakages, nor any heat required by the material to raise it to and maintain it at the temperature required to

do the drying. As none of these things exist in actual practice, it is either necessary to make up the loss by applying heat in some other way than by the heat obtained in the air or by increasing the volume of the air so as to have enough heat to take care of the losses to raise the air from its initial temperature, and to do the evaporating. This latter is what is usually done, as stated by the writer in last month's issue, and this usually results in the air being finally about 20 to 30 per cent. satuarated when it escapes from the dryer in actual practice.

Referring now to Prof. Kent's problem, all his figures go to prove our contention that air can be saturated to 100 per cent. when it is circulated by a blower. All that is necessary is to give it time enough to absorb all the moisture it can carry, whereby it will be cooled down, and thus become saturated. In average practice, however, this has the effect of slowing up the drying process beyond a point where it is efficient, and, besides this, in the drying of many substances, fermentation, discoloration, and other physical defects will appear which are permanently injurious to the substance if the temperature is allowed to get too low, and the air becomes too highly saturated at a low temperature. This statement is quite readily proven by Prof. Kent's tabulation. Referring to the 220° entering temperature, and 80° temperature of escaping air; his calculations would show that the air becomes saturated long before the temperature is reduced to 80°. Again, referring to the 300° entering temperature, and 100° outlet temperature; in this case the relative humidity of the escaping air is nearly 85 per cent. If the temperature were reduced down to about 95° this would show very close to complete saturation.

Prof. Kent's problem of 100 lbs. of sand and 20 lbs. of water might be used as an example by making certain modifications and employing some arbitary constants to fill in so that it would practically cover a real drying problem.

We have never come in contact with any substance which has to be dried *absolutely* dry; in fact, there is no use doing it because any substance so dried will immediately take up from 4% to 6% moisture on the average from the atmosphere as soon as it regains its normal temperature after leaving the dryer. We, therefore, will consider in this case 100 lbs. of sand, 19 lbs. of water to be evaporated; one pound of water retained in the sand after it leaves the dryer, and have figured on 15 lbs. weight of the mechanical equipment necessary to convey the sand through the drying apparatus and have allowed 35% for leaks from the drying plant and covering the heat necessary to take care of the losses by radiation from the walls, roof, floor, ducts, etc., of the dryer building.

Let us first consider raising the temperature from 60° F. to 200°, and that after the air has passed through the dryer, it leaves at a temperature of 100°. We will also take the specific heat of sand as 0.20; the latent heat of evaporation at 100° as 1,036 B. T. U. and the specific heat of the mechanical equipment of 0.13. We will have to raise the temperature of the sand from 60° to 200° and as there is 100 lbs. of this to heat, it will amount to 2,800 B. T. U.. We will have 19 lbs. of water to evaporate, which will be raised from 60° to 100°. This will make 760 B. T. U. There is one pound of water retained in the sand which will be raised from 60° to 200°, which will make 140 B. T. U. The latent heat of evaporation for 19 lbs. of water will amount to 19,684 B. T. U. Fifteen pounds of mechanical equipment raised from 60° to 200° will amount to 273 B. T. U. The sum of this is 23,657 B. T. U., and adding 35% will amount to about 8,343, which added to the above will make a total of 32,000 B. T. U. required for the dryer.

The heat given up by the air in the process of evaporation will amount to 200° minus 100° times 0.2375, which equals 23.75 B. T. U. per pound of air. As the dryer and the process will require 32,000 B. T. U., this divided by 23.75 equals 1,347 lbs. of air.

One pound of air at 100° completely saturated will carry 0.0428 lbs. of water. If the entering air at 60° is 50% saturated, then the air will contain 0.00545 lbs., which subtracted from the amount in the air when totally saturated, will leave 0.03735 lbs.

As we have to evaporate 19 lbs. of water, then dividing this by the amount of moisture one pound of air can take up before becoming completely saturated, will give us 509 lbs., and if we divide this latter by 1,347 lbs., which is necessary to furnish the heat and do the drying, we find that the air as it leaves the dryer will be 37.8% saturated.

The heat necessary to raise one pound of air from 60° to 200° will be 33.25 B. T. U. and this multiplied by 1,347 lbs., gives us 41,500 B. T. U., which is the total heat put into the air as admitted to the dryer. Dividing the total heat required by the dryer by the total heat put into the air, gives us 77.2% as the relative heat required by the drying process as compared with the total heat put into the air.

Now if we work out this problem along the same lines as outlined above, raising the air from 60° to 200° and allow the air to escape from the dryer at a temperature of 120°, the drying process will require 32,200 B. T. U. and it will require 1,695 lbs. of air to furnish the heat. We will only require 251 lbs. of air when completely saturated, which will give us a relative saturation when the air leaves the dryer of only 14.8% and the relative heat required for drying as compared with the total heat put into the air will be 57.2.

Carrying this on again, figured on raising the air from 60° to 200° and have the air leave the dryer at 88°, then the total heat required for the dryer would amount to 27,800 B. T. U. It would only require 836 lbs. of air to furnish the heat and it would take 818 lbs. of air completely saturated, which would give a *relative saturation of* 98% as the air leaves the dryer and the relative heat for drying to the total heat required for heating the air would amount to 100%. This latter shows that if the temperature is lowered down far enough and one disregards the length of time it will take to do the drying when such a low temperature is attained, then it is possible to have *the air leave the dryer completely saturated.*

One other example, showing a comparison of the results with a higher temperature in the dryer, but leaving at the same temperature as was given in the first case, will show that this has the effect of more than doubling up the relative saturation. For instance, if the air is heated from 60° to 300°, and leaves the dryer at 100°, the total heat required for drying would amount to 34,900 B. T. U. and it would only require 612 lbs. of air to furnish the heat and would require only 509 lbs. of air the same as in the first case to complete saturation. Hence, the relative humidity would be 83.2%. The total heat put into the air would be 47,600 B. T. U., thus the relative heat for drying to the total heat required for the air would be 73.3%, which is a lower ratio than in the first case.

The fine points of the art of drying do not lie so much in the ability of an engineer to determine the amount of heat required, nor the relative saturation of the air as it leaves the dryer, although it is necessary, of course, for him to have this ability. It does rest more on his experience with different products in knowing what is the critical temperature they will stand without injury; also what is the maximum amount of saturation that can be permitted within the dryer without causing any objectionable chemical reaction that will lead to fermentation, discoloration or other injury, as well as to obtain the best possible commercial balance in the speed with which the product can be dried at the least possible operating expense and initial investment.

How to Figure Economy or Cooling Coils.

As used in central station heating practice, economy coils are a necessary auxiliary to adapt existing piping in buildings to an outside steam supply. Data for figuring the sizes required for given conditions and the savings effected were presented by Walter J. Kline at the recent annual convention of the National District Heating Association. Mr. Kline described an economy coil as an indirect hot water radiator, arranged so that all condensate from the individual heating system must pass through it. Furthermore, it must be suitably enclosed and have controlled air inlet and outlet ducts. The necessity for their use arises from the fact that the condensate leaves the radiators at approximately 212° F. and unless a proper means is devised for utilizing a considerable portion of this remaining heat, the result is a continuous loss. The principal use for economy coils is in connection with those heating systems where the condensation is more than the minimum allowable, or in most cases up to about 212°.

FIGURING THE REQUIRED SURFACE RATIO.

A pound of steam at 0 lbs. has the following properties: Temperature, 212° F.; latent heat, 970.4 B.T.U.; sensible heat, or heat in the water or condensate, 180 B.T.U.

It is obvious that the exact ratio will be found, if we separately calculate the radiating surface necessary to transmit the latent heat and then calculate the economy coil surface necessary to conserve or extract the sensible heat in the condensate. If we assume an inside temperature of 70° and use a co-efficient of transmission of 1.8 B.T.U. per hour per degree difference per square foot of direct cast-iron radiation, we have $212 - 70 = 142°$, and the total B.T.U. per square foot of direct steam radiating surface per hour is $1.8 \times 142 = 255.6$ B.T.U. $970.4 \div 255.6 = 3.7965$ sq. ft. of surface required to radiate the latent heat in 1 lb. of steam in one hour.

In determining the relative amount of economy coils, certain assumptions must be made. Assuming a room temperature of 70°, and an outside air supply of zero, heated to 70°, the limit of effective cooling of condensation will be the room temperature, 70°. While this is not practically attainable, it will serve as a basis of calculation.

Then $70 \div 2 = 35°$, average temperature air supply. $212 - 70 = 142°$ total temperature reduction.

$$212 - \frac{212-70}{2} = 141°,$$ average temperature of condensation.

$141 - 35 = 106°$, average difference in

SAVINGS EFFECTED BY COOLING COILS AT VARIOUS DEGREES OF COOLING.

(A) Temperature trap discharge, deg. F....	212	212	212	212	212	212	212	212	212	212
(B) Temperature economy coil discharge, deg. F.....	212	150	140	130	120	110	100	90	80	70
(C) B. T. U. saved per pound	0	62	72	82	92	102	112	122	132	142
(D) B. T. U. utilized per pound, 970.4 + C...	970.4	1032.4	1042.4	1052.4	1062.4	1072.4	1082.4	1092.4	1102.4	1112.4
(E) Per cent. saved of total required C ÷ 970.4	0	6.37	7.41	8.45	9.48	10.51	11.54	12.57	13.60	14.60
(F) Pounds steam required per sq. ft. (970.4 × 500) ÷ D..	500	470	465	461	456	452	448	444	440	436
(G) Pounds steam saved per sq. ft. radiation.	0	30	35	39	44	48	52	56	60	64
(H) Total pounds saved by 1 sq. ft. coil, C × 5.....	0	150	175	195	220	240	260	280	300	320
(J) Value at $0.50 per 1000 lbs.	$0	0.075	0.0875	0.0975	0.11	0.12	0.13	0.14	0.15	0.16
(K) Per cent. profit on investment in coils..	0	15	17.5	19.5	22	24	26	28	30	32

temperature. 1.8 B.T.U. (Carpenter) x 105 = 190.8 B.T.U. transmission per square foot of coil surface per hour.

Therefore, 142 ÷ 190.8 = 0.744 sq. ft. of economy coil surface required to radiate the sensible heat available hourly in the condensate of 1 lb. of steam.

Having now determined the necessary coil surface (0.744 sq. ft.) and the necessary steam radiation surface (3.7965 sq. ft.) we find the ratio to be. 0.744 ÷ 3.7965 = 19.60%, or practically 1 sq. ft. of economy coil surface for each 5 sq. ft. of direct steam surface. This is the correct relation for new piping, although for safety a larger percentage is frequently installed.

NET PROFIT OBTAINABLE WITH COOLING COILS.

The all-important reason for economy coils is to reduce the total cost of heating. It will, therefore, be of interest to trace out the net profit obtainable. If we assume, for example, the limit of 70° as the lowest temperature to which the condensate will be reduced from 212°, each pound of steam contains 142 B.T.U. which can be saved.

For what may be considered average results where meters are used, 500 lbs. of steam condensed annually per square foot of radiation may be fairly assumed. Upon this basis, the heat transmitted by 1 sq. ft. of coil surface per season will be 970.4 x 500 = 485,200 B.T.U. This is the total quantity of heat required for heating.

If all or part of the heat in the condensate (142 B.T.U.) is utilized, the total available is 142 x 500 = 71,000 B.T.U., or 14.6% of the total required. Therefore, the total heat utilized from each pound of steam will be 970.4 + 142 = 1112.4 B.T.U., instead of only 970.4 B.T.U. (latent heat). The actual steam needed then will be 485,200 ÷ 1112.4 = 436 lbs. steam furnished, if economy coils are used. 500 lbs. — 436 lbs. = 64 lbs. saved per square foot of steam radiation.

It has been already shown that 1 sq. ft. of economy coil operates in connection with 5 sq. ft. of steam radiation. Therefore, each square foot of coil surface will be the means of saving 64 x 5 = 320 lbs. of steam. If steam is valued at only 50 cents per 1,000 lbs., the value of this saving is $0.50 x (320 ÷ 1000) = $0.16. This is equal to $0.16 (saving by 1 sq. ft. coil) ÷ $0.50 (cost of 1 sq. ft. coil) = 32% interest on the investment in economy coils.

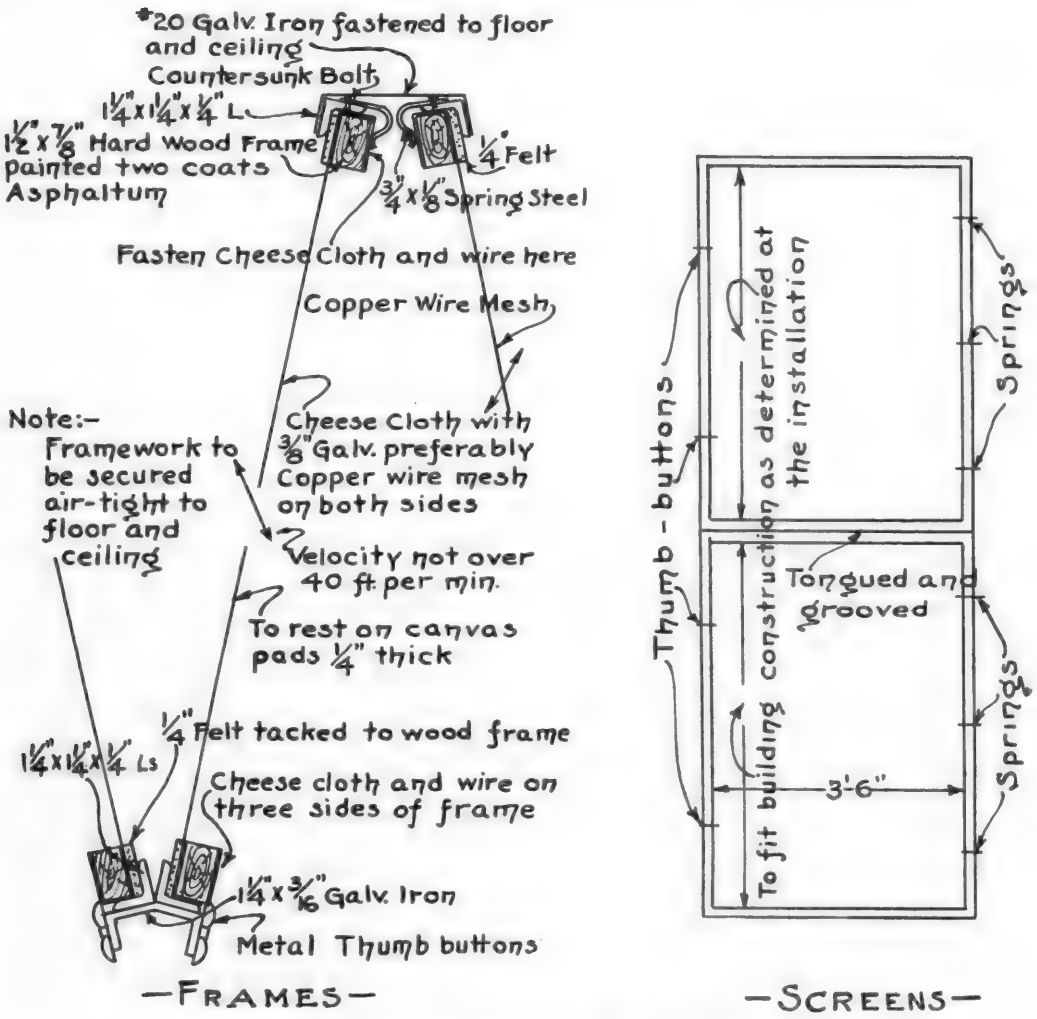
In the accompanying table the values are worked out on various degrees of cooling, with steam at 50 cents per 1,000 lbs., and the assumed annual constant of 500 lbs. per square foot. Other values of steam per 1,000 lbs. and other annual rates per square foot of steam radiation may be readily substituted, if desired.

Details of Zig-Zag Air Filters.

The construction of cloth air filters as described and detailed herein refers to those of the zig-zag type. These are arranged with the number of leaves to give the required net filtering area with a velocity of air for and through this type of filter not in excess of 40 ft. per minute.

The framework is constructed of No. 20 U. S. standard gauge galvanized iron, with 1¼x1¼x¼ in. angles, secured air-tight to floors, walls and ceiling by anchor bolts. These should be properly formed and stiffened and extended from side to side and from floor to ceiling of the fresh air intake chamber.

The framework is arranged to take the filter frames, the latter resting on canvas pads ¼ in. thick, with sufficient fasteners to maintain a tight joint all around. The


*20 Galv. Iron fastened to floor and ceiling
Countersunk Bolt
1¼"x1¼"x¼" L
1½"x⅞" Hard Wood Frame painted two coats Asphaltum
¼" Felt
¾"x⅛" Spring Steel
Fasten Cheese Cloth and wire here
Copper Wire Mesh
Note:-
Framework to be secured air-tight to floor and ceiling
Cheese Cloth with ⅜" Galv. preferably Copper wire mesh on both sides
Velocity not over 40 ft. per min.
To rest on canvas pads ¼" thick
¼" Felt tacked to wood frame
1¼"x1¼"x¼" Ls
Cheese cloth and wire on three sides of frame
1¼"x⅜" Galv. Iron
Metal Thumb buttons
—FRAMES—
Thumb-buttons
To fit building construction as determined at the installation
Springs
Tongued and grooved
3'-6"
—SCREENS—

DETAILS OF ZIG-ZAG AIR FILTER.

filter screens are built in sections convenient for handling, of two rows in height and in area not over 6 sq. ft. for any one screen, and are set in such a manner as to be easily removable for cleaning and repairs from the side where the necessary clearance and access may be obtained.

The filter leaf frames should be built of 1½x⅞ in. well-seasoned white pine, free from knots, and painted two coats of asphaltum. These frames are spread with ⅜ in. mesh galvanized or preferably copper wire netting on both sides of a good quality cheese-cloth of a suitable weave. The cloth is neatly stretched on all three sides of the frames with ¼ in. felt strips tacked to the wood frame as a backing between the frame and angles. The filter leaves should fit snugly to the iron framework, being held in place with metal turn buttons and ¾x⅛ in. steel springs. Allow not less than 18 in. for lateral spacing between leaves.

All woodwork should be properly protected against moisture by waterproof paint or varnish, and all metal parts should be painted two coats.

Where no other access is furnished, it is necessary to provide an access door from inside to outside of the air filter. This may be composed of one leaf arranged with independent frame and fitted with all required brass hardware for its proper hanging.

An extra set of filter leaves, consisting of wood frames, wire netting and cheese-cloth complete, should be furnished for use while cleaning those just removed. A vacuum cleaner may be used to good advantage for such cleaning.

Death of Edward Gurney.

Edward Gurney, president of the Gurney Foundry Co., Ltd., Toronto, Canada, the Gurney Heater Mfg. Co., Boston, Mass., and of the Gurney Massey Co., Ltd., Montreal, Can., died September 18 at his home in Toronto. He was 71 years old. Mr. Gurney had been in failing health for the past two years, but his death came quite suddenly.

Mr. Gurney was a public-spirited man as well as a keen and devoted industrialist. He was a clear thinker and polished speaker and never failed to captivate his audience by the undercurrent of quiet humor which pervaded nearly all his remarks.

He was the only son of the late Edward G. Gurney, a native of Holland Patent, N. Y., who, in company with his brother Charles, laid the foundation in Hamilton, Ont., in 1842, of the well-known foundry business of the E. & C. Gurney Company. Edward Gurney was born in Hamilton in 1845. He received a thorough training as a molder in his father's workshops and, in 1869, on being admitted to the firm, he removed to Toronto, where he was placed in charge of a new branch of the business. From a comparatively small beginning the works at Toronto have become the largest of their class in Canada and take rank with the largest concerns in the United States. In 1891 the firm became incorporated under the name of the Gurney Foundry Co., Ltd., with Mr. Gurney as president.

In addition to his interests in the Gurney Foundry Co., the Gurney Heater Mfg. Co. and the Gurney-Massey Co., Ltd., Mr. Gurney was vice-president of the Gurney Northwest Foundry Co., and president of the North America Life Assurance Co. of Canada. He was a member of the Toronto, National and Automobile Clubs. He also served as president of the Ontario Hospital Association in 1905 and was a governor of Grace Hospital. He was successively vice president and president of the Toronto Board of Trade, in 1896 and 1897.

Those who have been associated with Mr. Gurney in business found him a most delightful man to work with. His cheerful optimism and wonderful determination were a source of encouragement, while his shrewd judgment in matters of business made him a tower of strength in all matters requiring skillful handling.

Mr. Gurney leaves a wife, two daughters and two sons, E. H. Gurney and Cromwell Gurney, who have had the active management of their father's interests for some time.

Ohio Society of Mechanical, Electrical and Steam Engineers will hold its annual meeting in Columbus, O., November 16, 1916.

A British Tribute to the Superiority of American Pipe.

In a remarkable article which appeared in a recent number of The Ironmonger, of London, on 'The Manufacture of Water Pipes," the author, Percy G. Donald, makes some frank admissions regarding the superiority of American pipe over British, Canadian and German makes, the points including better packing methods, better threading, better manufacturing methods and greater economy in use.

The author refers especially to a project which he had in charge of laying pipe lines in Egypt. In unloading the pipe it was quickly seen that there was going to be a lot of trouble with damaged threads. The ends of the British pipes were protected only by a wrapping of canvas, while the strips of hoop iron screwed onto the ends of the Canadian pipe often left the thread ends exposed. The result was that a large percentage of the threads had to be run over. All of the American pipe was protected by a plate-iron stamping which absolutely protected the ends of the threads. The American pipe ends were also filled with a heavy fat mixed with black lead which prevented rusting, while the British pipes arrived dry and soon began to rust.

The author also calls attention to the greater length of American pipes and the fewer threads to the inch on the larger sizes, both points being commended as being more effective.

Praise is also given to the American practice of having one pipe for gas, water and steam, while the British have three, all of different weights. The American manufacturer, also, has nothing to do with fittings, and this is presented as an advantage.

Finally, in the matter of costs it is shown that the American figures are lower, although the labor costs in America are nearly double those in England, while the distance from the American works to the shipping port is from three to five times that of the British works.

In concluding, the author asks:

What better time than the present to create a proper standard, to scrap our absurd differentiations between gas, water and steam pipes, to scrap such unnecessary sizes as ⅝ in., 1¼ in., 1¾ in. and 2¼ in., to adjust our threads for the larger sizes, to leave to the fittings manufacturer the job of turning out fittings at comprehensive prices, and to make our profits on low costs?

Up to the present the Americans have not got into other markets owing to the

differences in their threads. But what is today's position? The export of tubes to foreign countries is prohibited. This means that the greater part of the world is bound to go to America for them, and where once the U. S. thread and pipe is adopted our opportunity of regaining the market is remote, unless our price and our goods are right.

Firms Now Manufacturing Smokeless Boilers.

An indication of the growing use of smokeless boilers is disclosed in the comparatively large number of firms which are now putting out lines of smokeless boilers to meet the ever-increasing demand. This list, revised to date, includes the following:

LOW PRESSURE STEAM AND HOT WATER BOILERS.

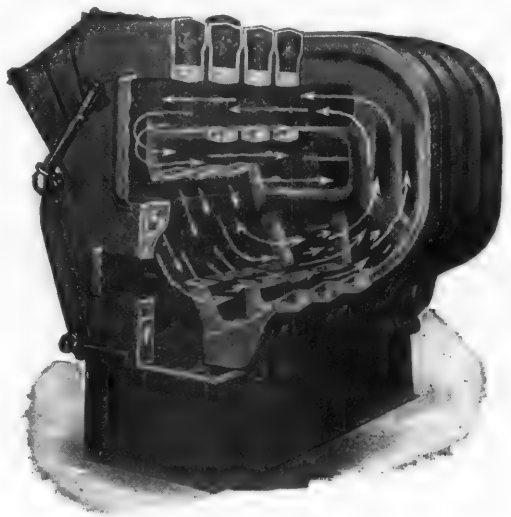
American Radiator Co., Chicago, Ill.
John Brennan & Co., Detroit, Mich.
Jesse C. Coogan, Milwaukee, Wis.
Gurney Heater Mfg. Co., Boston, Mass.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hart & Crouse, Utica, N. Y.
Herbert Boiler Co., Chicago, Ill.
Ideal Mfg. & Supply Co., Oskaloosa, Ia.
Kanawha Mfg. Co., Charleston, W. Va.
Kellogg-Mackay Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Molby Boiler Co., New York.
Oil City Boiler Works, Oil City, Pa.
Peck-Williamson Co., Cincinnati, O.
Peerless Heater Co., Pittsburgh, Pa.
Pierce, Butler & Pierce Mfg. Corporation, New York.
Prudential Heating Co., Akron, O.
H. B. Smith Co., Westfield, Mass.
Spencer Heater Co., Scranton, Pa.
United States Radiator Corporation, Detroit, Mich.

FIRE TUBE BOILERS.

Ames Iron Works, Oswego, N. Y.
John Brennan & Co., Detroit, Mich.
Brownell Co., Dayton, O.
Casey-Hedges Co., Cincinnati, O.
Freeman & Sons Mfg. Co., Racine, Wis.
Gem City Boiler Works, Dayton, O.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hawkes Boiler Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Murray Iron Works Co., Burlington, Ia.
John O'Brien Boiler Works Co., St. Louis, Mo.
Oil City Boiler Works, Oil City, Pa.
Titusville Iron Co., Titusville, Pa.
Vogt Machine Co., Louisville, Ky.

Pierce Down-Draft Boiler.

One of the most interesting types of down-draft boilers is the Pierce, manufactured by Pierce, Butler & Pierce Mfg. Corporation, New York, and shown in the accompanying illustration. The distinguishing feature of this boiler is the arrangement of the combustion chamber and the course followed by the fire travel. The draft comes from above the fresh coal, carrying the gases down and through the incandescent body of fire. In this way, it is stated, no gas escapes consumption and thus the boiler is made smokeless in operation, regardless of the kind of coal used. Emphasis is laid on the fact that the major portion of the fire-surface is self-cleaning. It



CONSTRUCTION OF PIERCE DOWN-DRAFT BOILER.

is also pointed out that the location of the magazine is such that it does not occupy valuable heat-absorbing space. The magazine holds enough coal to last twelve hours, in extreme weather, and twenty-four hours, in moderate weather.

The fact that any kind and size of coal or wood may be burned successfully in this boiler is, perhaps, its most remarkable feature and attention is called to the fact that the boiler is made up in the sectional push-nipple type, insuring rapid erection while, being of cast-iron throughout, the minimum of oxidization is assured.

Pierce down-draft heating boilers are furnished for both steam and water heating, there being nine sizes of each, the steam capacities ranging from 900 to 4300 sq. ft. and the water capacities ranging from 1500 to 7100 sq. ft.

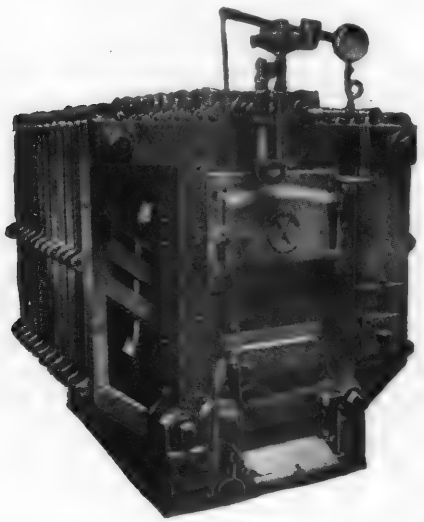
A Single-Grate Smoke-Consuming Sectional Boiler.

An unusual type of sectional boiler, being an adaptation of a pipe boiler first made in 1890, is an interesting product of the Ideal Mfg. & Supply Co., Oskaloosa, Ia. It is designed to be smoke consuming, but has only one grate. Charles Phelps, of this company, states that he has been making smoke consuming boilers of the pipe construction since 1890 which were distributed locally, and many of them are still in use. No changes have been made in them for over 10 years.

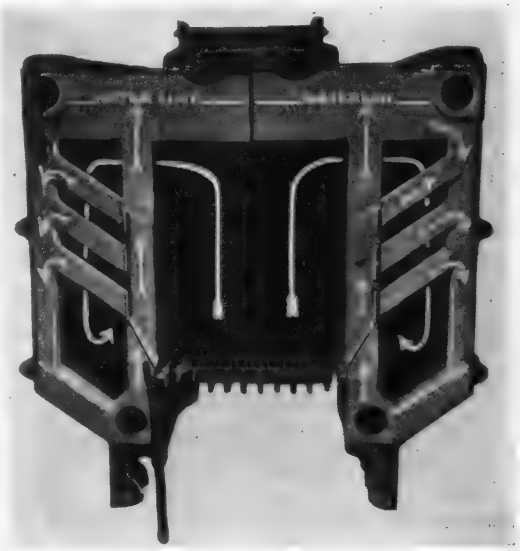
The sectional type which is known as the Phelps Ideal smoke consuming boiler is especially designed for burning soft coal and it is claimed that this boiler will keep steam anywhere from 2 to 10 hours with one soft coal fire, depending on the grade of coal used. In this connection users are reminded that the chimney inside area should be about 25% of the grate area of the boiler and the chimney should be at least ten times as high as the boiler to secure good results.

Smokeless combustion is obtained through the use of the round openings between the sections. These are intended to "allow the blaze from the live coals underneath the grate to pass directly out into the combustion chamber at eacn side of the fire box and ignite the unconsumed gases that are carried over in the main draft areas."

Among the other construction features it will be noted that the sections are closer together than usual, the sections being 4 in. from center to center. Each section has its own grate, ashpit and draft area. This



PHELPS IDEAL SECTIONAL SMOKE-CONSUMING BOILER.



CONSTRUCTION OF PHELPS IDEAL BOILER.

permits the draft to remain relatively the same with few or many sections. In having all the pipe connections made to the back sections the heater can be enlarged or reduced in size without changing any piping. The narrow sections permit of a large fire surface, this type having 30 sq. ft. of fire surface to each 1 sq. ft. of grate surface.

The two top openings near the center of the sections provide a steam header for dry steam. The hottest part of the fire is immediately underneath the header.

This boiler is made in two series, 24-in. and 36-in. for both steam and hot water radiation.

Smith Smokeless-Furnace Boiler.

Among the recent accessions to the ranks of the smokeless boiler manufacturers is the H. B. Smith Co., Westfield, Mass. This company has recently placed on the market a No. 36 Smith boiler, with and without smokeless furnace, for burning bituminous coals. In addition to this line the company is also about to make a larger boiler with smokeless furnace, to be known as the No. 60 Smith boiler, with 5-ft. grate.

The illustration on page 19 shows the construction features of the 36-in. series. While differing radically from other sectional heating boilers with furnaces designed for the smokeless combustion of soft coal, the Smith boiler with smokeless furnace follows, both in construction and operation, standard practice as seen in hand-fired

power boiler furnaces which burn soft coal without objectionable smoke.

In firing this boiler it is pointed out that for a short time after firing the fire doors or dampers in fire doors should be cracked open and they should remain open until all traces of smoke have disappeared, probably for one or two minutes. This excess air, it is stated, increases the efficiency of the boiler, as well as eliminating smoke.

The principal feature, however, in the operation of this boiler is described as the intimate mixing of burning gases with the air which supports their combustion. This, it is stated, has to be accomplished by the design of the furnace. Immediately after the gases have passed through the horizontal openings in the fire box or bridge wall, the gases go through the mixing chamber, terminating in the long, narrow, vertical flue which, it is claimed, mixes the burning gases and the air thoroughly and intimately and enables all the volatile matter to obtain the oxygen necessary for complete combustion.

At the same time the design, it is pointed out, permits the burning gases to be maintained at a temperature high enough for their complete combustion. This depends both upon the design of the furnace and the handling of the fire. Over the fire pot there is formed, between the sections, dead air pockets which, although they are claimed not to hinder the absorption of heat by radiation from the fire, do tend to keep the hot gases away from that portion of the cold surface of the boiler and help to maintain the gases at a hgh temperature.

The so-called coking method of firing is followed with these boilers, fresh coal being placed upon the front third or half of the grate. The volatile gases are driven off and pass over the hot fire on the rear portion of the grate. Here they are raised to the ignition temperature and, passing through the mixing chamber, are mixed with the air and burned.

When the volatile gases have been driven off and the coal has become coked, which requires from one-third to one-half the time between firings, it may be spread over the rest of the fire.

As time is required for the complete combustion of the gases, the combustion chamber in the rear of the boiler is furnished of varying lengths depending on the type of coal burned.

A great advantage of this line, it is pointed out, is that it may be installed as a hard coal boiler up to and including 13 sections without the smokeless furnace and may be adapted, if desired, to the use of soft coal by adding three or four more sections, including the vertical flue, and, if not already in use, the fire back section.

The 36 series (with smokeless furnace) is made in eleven sizes, ranging from 2750 to 5400 sq. ft. steam radiation and from 4550 to 8900 sq. ft. water radiation. The 60 series (with smokeless furnace) will be made in twelve sizes, ranging from 6000 to 11,750 sq. ft. of steam radiation and from 9900 to 19,400 sq. ft. of water radiation.

The Peerless Down-Draft Boiler.

Using the well-known principles of construction which are a feature of the Peerless line of steam and hot water boilers and which include the use of cup-shaped or hemispherical arches in the crown plate, as well as S-shaped water tubes or braces, the Peerless Heater Company, Pittsburgh, Pa., has recently placed on the market a down-draft boiler. The accompanying illustration shows the construction of this heater. Special emphasis is laid on the S-arm interior construction which, it is stated, gives in the smaller series an unusually high efficiency. The inside walls of this boiler are V-shaped, as are the other boilers of the Peerless type. The points of the V project into the fire zone, adding, it is stated, one-

CONSTRUCTION OF PEERLESS DOWN-DRAFT BOILER.

third more prime surface than would be the case with a flat wall.

Owing to the greater chimney capacity required for down-draft boilers, the company presents the following table of the minimum sizes of chimney which should be used.

	Size Chimney, In.
Boilers up to 2,075 sq. ft. steam	12x12x40
Boilers from 2,075 to 2,600 sq. ft. steam	12x12x50
Boilers from 2,600 to 3,800 sq. ft. steam	14x14x50
Boilers from 3,800 to 5,000 sq. ft. steam	16x16x65

The Peerless down-draft boiler is made in one series (38) for steam and hot water, with nine sizes in each series ranging from 1,650 sq. ft. steam and 2,700 sq. ft. water to 5,000 sq. ft. steam and 8,500 sq. ft. water.

Recent Tendencies in the Smokeless Boiler Field.

As one of the pioneer down-draft boiler makers of the country a discussion of smokeless boilers would not be complete without some word from A. G. Cripps, vice-president and sales manager of the Prudential Heating Co., Akron, O., and the designer of the Prudential boilers and Cripps down-draft boilers. In recounting his experiences in this field, he writes:

"About 1908 we started to develop an entirely new feature in cast-iron boiler construction, and in doing this we originated the first all cast-iron down-draft boiler placed on the market in this country. We were ridiculed to no small extent by many of the large institutions as to the merits of the undertaking, but so far as the success of the thing is concerned, this is proven, we think, to the entire satisfaction of the trade at large by the fact that every manufacturing concern in the country, with few exceptions, has developed, or is trying to develop, something along the same line in order to hold the trade that is being lost to them by the standard makes of down-draft boilers. Not only are these boilers proving themselves to be a success, so far as the elimination of the smoke nuisance is concerned, where soft coal is burned, but they have invariably developed a saving of from 25 per cent. to 30 per cent. in fuel consumption.

"Not many years back, large buildings, such as school houses, court houses, business blocks, and large churches were heated by the ordinary horizontal tubular boiler. To-day, the cast-iron sectional boiler, and largely the down-draft type, is being given the preference for this class of work.

"The strong tendency, during the past few years, along the line of improving the heating and ventilating in large buildings of a public nature has increased the demand for large boilers and in many instances two, three and sometimes more large units are used to do the work. On account of the valuable space occupied by these boilers, the cast-iron boiler has become very popular on account of its adaptability to smaller spaces than the old horizontal tubular brick-set boilers. The writer knows of several cases where old tubular boilers were worn out, and new boilers bought of the sectional cast-iron type, and the saving in fuel was proven to be 30 per cent., as compared with the previous installation.

"There is no doubt in the writer's mind that the time is near at hand when any boiler of over 3,000 sq. ft. capacity will invariably be specified to be of the down-draft type, as it does not take long nowadays to convince the consuming public of an improvement that is as plainly shown as the development of the down-draft feature."

Smokeless Boilers Here to Stay.

According to J. B. Bernhard, manager of the boiler department of the Kanawha Mfg. Co., Charleston, W. Va., and the designer of the Bernhard water-tube boilers, the smokeless boiler has come to stay.

"In olden times," he writes, "it was said that the direct route to a man's heart was through his stomach, but in the twentieth century it has been discovered that a more direct route is through his pocketbook.

"In the larger cities the dense black smoke from the chimneys of manufacturing plants has caused complaints from the people. This agitation brought about ordinances for the prevention of smoke. The manufacturers, believing that these ordinances would work a hardship on them, and in order to make the laws distasteful to the people, had the ordinances to cover all boilers. Where the ordinances were enforced, it was found that instead of a hardship, the result was a benefit in the saving of coal that was formerly wasted.

"The old method of throwing fresh fuel on a hot fire and causing volumes of dense smoke has been proven very wasteful, while the new method of burning the fuel smokelessly has proven highly efficient and economical. We brought out the Bernhard smokeless boiler expecting to sell it only where smoke preventative ordinances were

enforced, and at first this was true to some extent, but at present we are selling a large percentage of these boilers in cities having no such ordinances.

"The great saving of fuel makes the smokeless boiler a wonderful investment. It will not be long before all boilers, except the smaller sizes, will be of the smokeless pattern in territory where soft coal is used for fuel.

"When people learn that the boiler that makes smoke is wasting fuel, they will buy the smokeless type. The man of today is always willing to spend a little extra money when he knows the interest on his investment will be large. The smokeless boiler is a money saver."

Directions for Firing a Boiler Without Making Smoke.

The following directions are being sent out by the Nashville, Tenn., Smoke Inspection Department in poster form, under the caption "Don't Make Smoke." Directions for firing down-draft furnaces without smoke: To start fire, place wood on top and bottom grates. Light wood. Put coal on top grate. When coal begins to burn, build up fire on upper grate until it is 8 in. thick. Never put coal on lower grate. When fire is started, don't fire any coal bigger than your fist. Carry a thick fire on top grate, 8 in. or more. Keep fire level by firing on bright spots. Don't let any holes burn in fire. Don't poke top of fire.

Slice fire on top grate by running slice bar along grate under fire. Keep fire on bottom grate level and clean. Keep ash pit clean. Clean flues once a day.

Watch your stack. Don't make smoke. If you have trouble in keeping down smoke, call Martin A. Rooney, smoke inspector, City Hall.

New Books.

THE ENGINEER IN WAR, by Major P. S. Bond, is the subject of a manual describing the requirements that American engineers would have to meet in case the United States should ever become involved in a large war. The author draws freely on the lessons learned by the present European war and the book is replete with illustrations, many of them made from photographs of trenches and other defensive works on the battlefields of France. The book presents a strong argumeut for preparedness on the part of engineers, as well as on the part of the general public. Price $1.50. Published by the McGraw-Hill Book Co., New York, or may be obtained through the book department of THE HEATING AND VENTILATING MAGAZINE.

POWER FOR PROFIT, covering the principles governing the use of machinery and labor in modern buildings, by Reginald Pelham Bolton, has been published by the R. P. Bolton Co., consulting engineers, New York. The volume is broad octavo, 11 x 8 in., 200 pages, handsomely bound in cloth for table use, and has a full index, in addition to marginal notes, red-lettered for ready reference. The book is intended for the use of owners of buildings, operators in real estate, trustees, managers, builders and architects. The cost and the life of machinery in modern buildings and their operating conditions are analyzed in the interests of the income-producing real estate, as well as from the point of view of institutions and of municipal ownership. Analyses are also given of the much-discussed value of exhaust steam for heating purposes and of electric energy regarded as a by-product of steam. In discussing exhaust steam the author makes the point that the value of exhaust steam may be offset entirely by accompanying losses in production. He is referring in this connection to a climate similar to that of New York City where, he says, "the utilization of exhausted steam in the heating apparatus of buildings occupied by the power plants is proved to be no more than one-third of the total steam raised during the year, and this only where the conditions are favorable to such a combination."

Throughout this and other sections the author's arguments are presented tersely, but in a lucid style that adds much to the readableness of the volume.

The whole presentment of the subject is directed towards a reconsideration of existing combinations of machinery by analysis and the reduction of such wastages by the adoption of improved methods and apparatus. These considerations are applied to steam and gas, as well as to electricity. The book may be had directly from the publishers or from the book department of THE HEATING AND VENTILATING MAGAZINE.

New Publications.

FLOW OF WATER IN WOOD-STAVE PIPE is the title of a new professional paper of the U. S. Department of Agriculture (Department Bulletin No. 376) by Fred C. Scobey, irrigation engineer. The bulletin is based upon the results obtained through a large number of experiments on the flow of water in wood-stave pipes ranging from 8 in. to 13½ ft. in diameter. The work also included the collection and analysis of available records of all previous experiments of a similar character. From the results of all experiments made,

there has been deduced a new set of formulas for the flow of water in stave pipes, which is presented in the bulletin.

The bulletin is highly technical in character, and its distribution is limited to engineers and others concerned with the use of wood pipe for conveying water for irrigation, power, municipal, mining, and similar purposes. Application for the bulletin shoud be addressed to the U. S. Department of Agriculture, Washington, D. C.

PROCEEDINGS OF THE NATIONAL DISTRICT HEATING ASSOCIATION'S eighth annual convention, held in New York, May 16-19, 1916, are out in bound volume form, making a book of 470 pages. In addition to the papers, reports and discussions, the volume contains a full list of members, Class A and B members being arranged alphabetically and Class C and associate members being arranged according to States. In addition to the index for the volume itself, there is included an index to the proceedings of previous conventions from 1909 to 1916, inclusive.

DRY PREPARATION OF BITUMINOUS COAL AT ILLINOIS MINES is the title of a new bulletin (No. 88) issued by the Engineering Experiment Station of the University of Illinois, and containing an extensive study of the methods employed in this connection. The data and tables were compiled by Professor E. A. Holbrook. The results are sub-divided into (a) evolution of present preparation practice, (b) standard types of tipples or preparation plants, (c) impurities and breakage of coal, making preparation necessary, and (d) sizing and sizes of Illinois coal. A record is presented of the yearly production of the different sizes of coal in Illinois over a period of 35 years, agreements between operators and miners as affecting preparation are discussed, and requirements for standardization are studied. Copies of the bulletin may be obtained on application to W. F. Goss, director, Urbana, Ill.

HEALTH CONSERVATION AT STEEL MILLS, by J. A. Watkins, passed assistant surgeon, U. S. Public Health Service, is discussed exhaustively in a recent technical paper (No. 102) issued by the Bureau of Mines, Department of the Interior. After taking up medical supervision of employees, fatigue as a cause of occupational disability and the relation of industrial buildings to health of employees, the author has the following to say on the subject of ventilation:

Adequate ventilation of the workshop should be considered from two points of view: (1) That of air renewal; (2) that of removal of products formed in the industrial processes.

The removal of air in a worshop does not differ in essentials from that in any other building; and it is as difficult to formulate any definite rules, for there are so many factors to be considered that each case must be taken up separately. It is preferable that air renewal be accomplished so far as possible by natural means, through windows, transoms, skylights, etc., and attention should be given these fixtures with this end in view. They should be of ample size and readily removable, being preferably on pivots to permit opening in the horizontal or vertical plane. This arrangement will make it possible, also, to control in some degree the air currents and to direct them where desired. Where it becomes necessary to heat the air, steam or hot-water coils may be placed below or near the intakes, windows, ventilators and the like.

The products formed, such as fumes, gases, or dust, and harmful conditions of temperature or humidity incident to industrial processes, must receive additional attention.

The formation, escape, and distribution of dusts can be prevented, or the rust can be removed from the air when once set free. Prevention is far more desirable, and in many instances may be done by sprinkling, as at the stockyards.

Where it is impracticable or impossible to prevent dust from becoming suspended in the air, the process of manufacture that produces the dust should be carried on in a separate, well-ventilated location, as few persons as possible should be exposed, and they should all be required to wear respirators. A respirator should effectively remove all suspended matter from the inhaled air, should be light and comfortable to wear, and should not interfere materially with the respiration; however, a perfectly satisfactory respirator is yet to be devised.

The only effective means of removing dust in workshops is by a carefully designed and constructed exhaust system. The place to collect and remove dust is at its source. Where this is at grinding or mixing wheels a suitable hood of substantial construction, preferably of steel, should be installed.

After systems for the removal of dusts have been installed, there must be frequent inspection and adequate maintenance.

In discussing temperature and humidity, the author says: The combination of high temperature and high humidity in many modern industrial establishments eventually affects injuriously the health of those exposed, especially if the exposure is pro-

longed or attended by physical exertion. The economic effect of such conditions is a decrease in the efficiency of the worker—that is, a lowering in the amount and character of the work performed. Continued exposure to high temperature and humidity increases the susceptibility to disease and may cause muscular and point pains, aches, cramps, and, in extreme cases, heat exhaustion. Continued exposure will eventually cause anemia and skin eruptions, and tends to induce premature old age. There seems little doubt that the temperature to which many workmen are exposed could be materially lowered and that the duration of the exposure and the amount of physical exertion required while so exposed could be decreased.

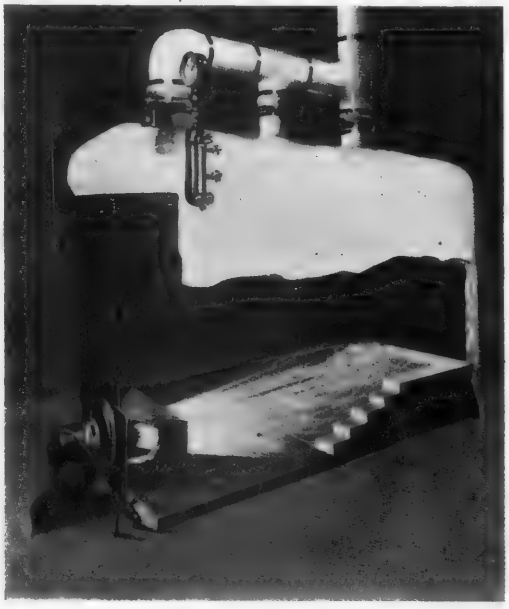
Buildings in which the processes are such as to require those employed therein to be subjected to high temperature or high humidity should be so constructed as to aid, by all natural means, a free circulation of the air. They should be large, with ample floor space. It is of special importance that the roof be placed high and provision made for the escape of heated air. The temperature can also be materially lowered by leaving several large openings in the walls, though undue drafts on those workmen who are overheated should be avoided. A rapid circulation of air created by natural means alone lowered the temperature 30° F. in the working location at one steel plant in the Pittsburgh district.

NEW DEVICES

Improved Rotary Oil Burner.

An improved rotary oil burner, especially adapted for heating boilers, has been brought out by J. C. Johnson, of the S. T. Johnson Co., San Francisco, Cal. The new device is known as the Johnson multiple disc rotary burner, and it is stated that it will produce perfect atomization. The new multiple disc is designed to throw oil from no less than six lips, thus breaking it up and giving the desired mixture. It is well-known that the more perfect the atomization of the oil, the better will be the combustible mixture and the lower air pressure which can be carried.

The new Johnson device sends the oil supply direct to the atomizer, instead of passing throuph a hollow shaft, consequently there is no packing in the shaft to cause friction.



THE JOHNSON IMPROVED ROTARY OIL BURNER.

Trade Literature.

CLARAGE KALAMAZOO MULTIBLADE FANS, described as showing an unusually high efficiency, and noted for their quietness of operation, and guaranteed to be amply strong for working against static pressures as high as 5 in. water gauge, are the subject of a new catalogue issued by the Clarage Fan Co., Kalamazoo, Mich. The company announces that this type has been developed as the result of a series of tests extending over two years and the fans are now presented to the trade with the assurance that they will be found at least the equal of any fan built for handling large volumes of air or gases against comparatively low pressures. For convenience in specifying and ordering, the fans are numbered according to the approximate diameter of the wheel in feet. Capacity and dimension tables are included in the catalogue for each size. The catalogue concludes with George Fitch's skit on Kalamazoo, which starts off by saying:

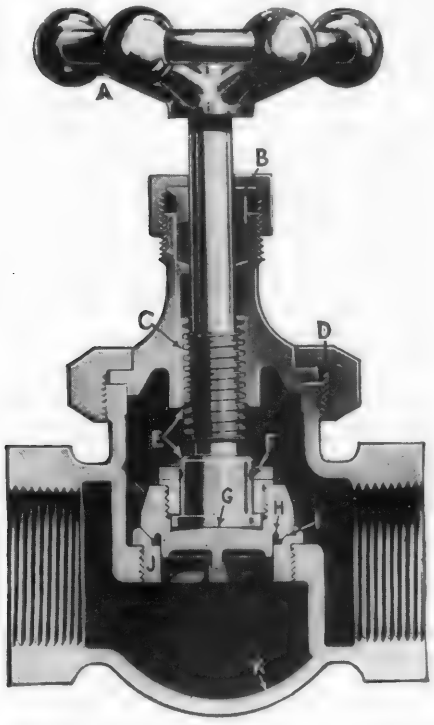
"Kalamazoo is like New York and Chicago and Shanghai and London and St. Petersburg in one important respect—There is only one of it.

"The man who invented Kalamazoo's name didn't patent it, but he was safe enough. No one has stolen it. For seventy-five years Kalamazoo has struggled along and never has any ambitious young city annoyed it by calling itself 'New Kalamazoo' or 'Kalamazooville' or 'Kalamazoo Center.'

"Thousands of people who don't know whether Kalamazoo is a breakfast food or a new kind of disease have murmured its name lovingly and have taken it home to try on

their pianolas. Everybody is familiar with Kalamazoo, but few know whether it is an institution or is played like a piccolo."

AMERICAN VALVES, globe, angle, cross and check, all bronze, of one design only, regrindable and renewable, for heavy and extra heavy service, are a new product of the American Steam Gauge & Valve Co., Boston, Mass., described in a recently-issued



CONSTRUCTION OF NEW AMERICAN GLOBE VALVE.

catalogue. This company, which has the reputation of being the largest manufacturer of gauges and safety valves in the country, states that the new line has been designed with the express purpose of making it equal, in quality and service, the reputation of American pop safety and relief valves. The valves are offered with the same guarantee that goes with each of the company's long established products. Size 6x9 in. (standard). Pp. 24.

CONNERSVILLE EFFICIENCY, a leaflet sent out by the United Vacuum Appliance Co., Connersville, Ind., manufacturers of the Connersville vacuum cleaners, contains the substance of some U. S. Government efficiency tests. The Connersville is compared with several other types of vacuum producers, and shows a higher overall efficiency in each case. The tests, the company states, are authentic proof of the superiority of the Connersville double impeller rotary blower as a vacuum producer, and adds that all Connersville vacuum cleaners are built around this blower. For ordinary uses the company's standard machines are offered as suitable for giving any cleaning results desired. For special conditions the company's staff of engineers is prepared to work out an equipment to meet any given specifications.

MUELLER EMPLOYEES' ANNUAL OUTING, describing the field day of the office and factory force of the H. Mueller Mfg. Co., Decatur, Ill., at Fairview Park, Decatur, August 12, 1916, is the subject of a souvenir number of the Mueller Record, the company's monthly periodical. Views are shown of the company's force parading through Decatur's streets, as well as of the principal events at the park. The address delivered by Mayor Dan Dineen, President Adolph Mueller and Attorney A. G. Webber are all given in full. The number will be a lasting record of one of the most notable affairs of its kind ever carried out by an industrial firm.

Some Notable New Sturtevant Catalogues.

If any doubt remained that the fan manufacturers were not giving freely of their knowledge and data to the public at large, it would be dispelled by the notable catalogues recently published by the B. F. Sturtevant Co., Hyde Park, Mass. Two of the latest of these catalogues are entitled, respectively, "Sturtevant Heaters" and "Sturtevant Multivane Volume Fans." Others of the company's recent catalogues are entitled "Sturtevant Electric Fans" and "Sturtevant Economizers in the Power Plants of Paper Mills."

The volume on Sturtevant heaters (Catalogue No. 230 of the Sturtevant Engineering Series) covers the company's line of mitre-type, return bend, London type and solid base heaters, together with pumps and receivers and steam traps. The first part of the book describes the operation, construction and mechanical details of Sturtevant heaters, and is intended for those who are not buying this class of apparatus regularly. The latter part, which gives performance tables, diagrams and dimensions, is for the benefit of engineers, architects and master fitters, and is designed to assist them in choosing the heater necessary for any given building. Diagrams showing proper methods of making steam connections and the space occupied by heaters are also included. The fact that the company has been making heaters for more than forty years is presented as evidence of the class of work turned out. Every detail connected with the design and installation of these heat-

ers, including numerous typical installations, is taken up at length.

The special sections for engineers and architects include one devoted to tables, dimensions and engineering data; another devoted to piping diagrams, pipe sizes and drawing symbols for all types of Sturtevant heaters; a third giving an important series of tables showing temperature rises and condensations for all types of Sturtevant heaters; and a fourth, giving temperature rise curves and miscellaneous information. This volume is 8¼ x 10¾ in., as are the others, and contains 132 pages. An index at the back adds considerably to its usefulness.

The volume on Sturtevant multivane volume fans (Bulletin 228) is equally exhaustive, being taken up entirely with tables of dimensions, capacities, horse-powers, etc. Pp. 100.

The volume on Sturtevant electric fans is prepared with equal care, and features telephone booth ventilators, forge blowers, dust blowers, electric heat blowers, portable ventilating sets, propeller fans, tractrix fans, disc fans, multivane fans (Designs 2 and 3), steel plate fans, monogram fans and steel pressure blowers. Pp. 60.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Michigan Chapter.

The first meeting of the fall season of the Michigan Chapter was scheduled for October 9, in the rooms of the Fellowcraft Club, Detroit, the speaker being Ira N. Evans, formerly with the Evans-Almirall Co., of New York, but now associated with Johnson, Larsen & Co., of Detroit. Mr. Evans's subjeect was "Hot Water Heating."

The present membership of the Michigan Chapter, including the applications now in the hands of the membership committee, is 71.

Massachusetts Chapter.

The Massachusetts Chapter opened its Fall season with a meeting at the City Club, October 10. The subject for discussion was "Automatic Temperature Control and the Early History of Same," by T. F. McCoy, illustrated by lantern slides.

Petersen-Green.

The marriage is announced of Gustave Petersen, secretary and treasurer of the Heating and Ventilating Magazine Co., New York, to Miss Ethel Gladys Green, daughter of Mr. and Mrs. Fred. D. Green, of Cleveland, O. The ceremony took place September 14 in Cleveland. Mr. and Mrs. Petersen left immediately after for a two weeks' wedding trip in Maine.

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TRADE AND MISCELLANEOUS NOTES

Coming Events.

October 24-27, 1916.—Annual meeting of the American Public Health Association, in Cincinnati, O. Secretary, Selskar M. Gunn, 755 Boylston Street, Boston, Mass.

December 5-8, 1916.—Annual meeting of The American Society of Mechanical Engineers, in New York. Headquarters at the Engineering Societies Building, 29 West 39th Street, New York.

Third Monday in Each Month (commencing in October).—Meeting of the New York Chapter, American Society of Heating and Ventilating Engineers, in New York (evening).

Second Monday in Each Month (commencing in October.—Meeting of the Illinois Chapter, American Society of Heating and Ventilating Engineers, in Chicago (evening).

Third Tuesday in Each Month (commencing in October).—Meeting of the Massachusetts Chapter, American Society of Heatind and Ventilating Engineers, in Boston (evening).

Second Thursday in Each Month (commencing in October).—Meeting of the Eastern Pennsylvania Chapter, American Society of Heating and Ventilating Engineers, at the Engineers' Club, 1317 Spruce Street, Philadelphia (evening).

First Monday of Each Month (commencing in October).—Meeting of the Michigan Chapter, American Society of Heating and Ventilating Engineers, in Detroit (evening).

Second Monday of Each Month (commencing in October).—Meeting of the Ohio Chapter, American Society of Heating and Ventilating Engineers, in the rooms of the Cleveland Engineering Society, Chamber of Commerce Building, Cleveland (evening).

Deaths.

William Watson Lawrence, president of the National Lead Co., New York, died

Genuine Armstrong Stocks and Dies

MALLEABLE HINGED PIPE VISES

PIPE CUTTERS

PIPE MACHINES, HAND OR POWER

The Tools of Constant Service

Manufactured by — Write for Catalog

THE ARMSTRONG MFG. CO., 321 Knowlton St., BRIDGEPORT, CONN.

"THE DAHLQUIST"

Copper Hot Water Boilers

For Large Apartment Houses, Hotels, Hospitals, Restaurants, and Public Institutions.

Long and Reliable Service Guaranteed.

Engineers recognize the high character of our product by specifying "The Dahlquist Boilers" on their most exacting work. Write for catalogues

DAHLQUIST MFG. CO., 40 West 3rd Street, BOSTON, MASS.

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

August 29, after an illness of several weeks. He was 57 years old, and had long been identified with the white lead industry.

Mrs. George H. Reynolds, wife of the first secretary of the National Association of Master Steam and Hot Water Fitters, died at her residence in Chicago, September 14.

Miscellaneous Notes.

New York.—In connection with the filing of plans in New York recently for new buildings of the skyscraper type, many of which were rushed through for filing before the new zoning and building heights act went into effect, the superintendent of the local building bureau has announced that while all such plans (covering a cost of $40,000,000) were properly filed prior to the expiration date, July 25, it is necessary that such plans, to be effective, be approved within three months. This is in accordance with a special resolution in the zoning act. Unless these plans are approved, therefore, and conform in all requirements to the former code, by October 25, they will virtually be outlawed.

National Safety Council, an employers' organization, started about three years ago, for the purpose of establishing a clearing house of information on accident prevention, sanitation, health conservation, etc., will hold its annual meeting in Detroit, Mich., October 17-20. The council now has a membership of 2200. A unique feature of its service is the publication of five bulletins a week to each member, or 250 a year, transmitting to the employer the most approved means and methods of reducing accidents. A feature of the convention will be a safety exhibit. An elaborate programme has been arranged. Sessions will be held at the Statler Hotel. The Wednesday morning session (October 18) will be a public utilities sectional meeting and several sessions will be devoted to health service.

William M. Mackay, president of the Mackay Mfg. Co., New York, is receiving congratulations on having reached the 45th anniversary of his connection with the heating business on September 12. Mr. Mackay served his apprenticeship in the heating, plumbing and lead burning business in Canada. During his long connection with the heating trade he has designed several well-known types of boilers, including the Manhattan line of steam and hot water boilers,

Mail the Coupon for Your Copy

of this big catalog, which contains lots of valuable information, data, charts and suggestions for specifications on Air Line and Return Line Vacuum and Vapor Heating Systems, and illustrates and describes thoroughly the big line of RELIABLE Vacuum and Vacu-Vapor Heating Equipment—RELIABLE Vacuum Pumps, VacUstats, Vacu-Traps, Vacu-Checks, Vacu-Graduate Packless Radiator Valves, "4 V" Vent Valves, etc. This will not obligate you. We want you to see this catalog. You will be interested in it!

The B. B. B. Company Cleveland, Ohio

Please mail your big catalog of RELIABLE Vacuum and Vacu-Vapor Heating Equipment to

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Address .....

H.& V.-616

THE BISHOP-BABCOCK-BECKER COMPANY

General Offices, Cleveland, O.

Branches in the Larger Cities

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

which are made by the Mackay Mfg. Company in accordance with Mr. Mackay's designs and under his patents.

Thomas J. Douglass, senior partner of the heating contracting firm of Thomas J. Douglass & Co., Chicago, Ill., who was injured several weeks ago when his automobile was overturned by a motor truck, has almost fully recovered from the accident.

Pipe Fittings and Valve Exchange has been formally elected a member of the Chamber of Commerce of the United States. The Pipe Fittings and Valve Exchange will appoint a national councilor as its representative in the Chamber of Commerce.

St. Louis, Mo.—As the result of the appointment of a receiver for the Hanley-Casey Co., Chicago, heating and ventilating contractors, which has the heating contract for the Missouri State House, at Jefferson City, 40 men were laid off on that job. The contract in question amounted to over $350,000.

Toledo, Ohio, reports an unusual business growth during the past year, no less than $1,346,197 of building permits having been issued in August alone. Permits for the entire eight months of 1916 represent a total valuation of $7,254,428, an increase of about 50% over the same period last year.

Building Operations for August, 1916, continued the good showing of preceding months. The figures for 112 cities, compiled by the American Contractor, were $72,397,168, as compared with $71,449,039 for August last year. This is a slight increase which is all the more remarkable in view of the fact that in New York last month an excessive number of building permits were issued, valued at over $40,000,000, due to the passage of the zoning and building heights law. The figures for New York for August are $9,932,356, as compared with $14,670,982 a year ago, showing that in spite of the heavy July showing, building activity is still pronounced in the metropolis. Important gains were reported from Akron, O.; Albany, N. Y.; Detroit; Elizabeth, N. J.; Indianapolis, Minneapolis, Pittsburgh, St. Louis, Toledo and Washington, D. C. Losses were reported from Chicago, Cincinnati, New York and Savannah.

The Chicago figures were $5,783,000 this August, as against $9,513,159 last August.

Manufacturers' Notes.

Consolidated Engineering Co., Chicago, Ill., announces the election of Walter E. Barnes as president of the company, taking the place made vacant by the death of Byron E. Van Auken. Other officers of the company are John F. Hale, vice-president, and B. E. Gordon, Jr., secretary.

Syracuse Faucet & Valve Co., Syracuse, N. Y., has been merged with the Syracuse Gauge & Valve Co., which has been incorporated with a capital stock of $100,000 to take over the former company, as well as the Azadian Gauge Mfg. Co., also of Syracuse. The company is planninng to occupy a new plant, manufacturing the products of the former companies, including packless

Jenkins Bros. Brass Valves

The special grade of new steam metal used, the heavier, stronger construction, the unsurpassed design and workmanship, the Jenkins Renewable Composition Disc make these valves longer-service valves. They withstand the strains of expansion and contraction, the lifting and settling of piping, much better than light valves not built to a service standard. There's a Jenkins Bros. Valve for every purpose—Write us for catalogue No. 20.

Jenkins Bros.

New York Boston Philadelphia Chicago Montreal London

SPECIFY FOXBORO INSTRUMENTS

TRADE MARK

TO INDICATE or RECORD TEMPERATURES and PRESSURE

They have a distinctive quality with a fineness of mechanical detail which insures Accuracy and Durability under the hardest Service

THE FOXBORO COMPANY, FOXBORO, MASS.

New York Chicago St. Louis Birmingham, Ala. San Francisco

radiator valves, steam, air and water gauges, and thermometers.

H. Mueller Mfg. Co., Decatur, Ill., held the annual outing of its 700 employees at Fairview Park, near Decatur, August 12. The party paraded from the plant to the interurban station, automobiles being provided for the women. Arriving at the park, addresses were made by Mayor Dineen of Decatur, followed by the election of W. C. Heinrichs as president of the "Forty-Niners," the company's organization of salesmen. In the afternoon President Mueller addressed the gathering on "Co-operation Between Employer and Employee." Mr. Mueller also emphasized the duty of loyalty to the United States, on which the company has taken a strong stand, with special reference to industrial preparedness and the remuneration of employees entering military service. Checks for $500 each were then presented to two of the 20-year men, Edward W. Larrick and Theodore Schepper. The remainder of the day was devoted to athletic events, followed by supper in the park pavilion and then dancing. The company distributed 4500 street car tickets in addition to hundreds of tickets for luncheon.

Sarco Co., Inc., New York, manufacturer of the Sarco line of thermostatic radiator traps, steam traps and temperature regulators, has opened a new office in Philadelphia, at 963 Drexel Building. F. C. Perkins has been appointed Philadelphia manager.

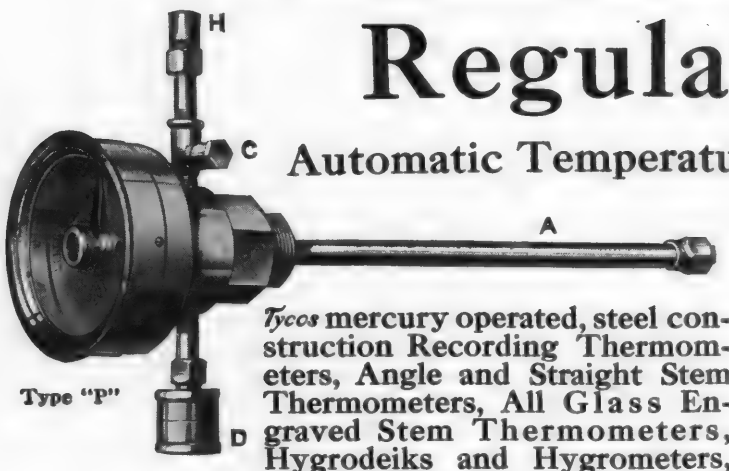
Parker Supply Co., New York, makers of the Parker line of expansion shields, screw anchors, sheet metal screws, damper quadrants, has established a branch office in Chicago at 627 West Jackson Boulevard. J. S. Jacobs is in charge. A large stock of the various Parker products will be carried at the Chicago branch.

Thomas P. Ford Co., New York, manufacturers of the Ford steam and water specialties, announces the appointment of E. H. Bolton and H. A. Hurckes as distributors of the Ford specialties in the Middle West. Mr. Bolton has been connected for some years with the Colles Heater & Specialty Co., Chicago, as sales engineer. Mr. Hurckes was for many years chief engineer for the Illinois Vinegar Mfg. Co., Chicago. The company states that copies of its catalogue (No. 15), showing the complete Ford line, including automatic return check and stop valves, can be obtained by dropping a line

H&M Thermometers

Regulators

Automatic Temperature and Pressure



Type "P"

Tycos mercury operated, steel construction Recording Thermometers, Angle and Straight Stem Thermometers, All Glass Engraved Stem Thermometers, Hygrodeiks and Hygrometers, Thermo-Electro and Radiation Pyrometers.

Mark this: — Every Instrument bearing H & M *Tycos* makes honest claim to supremacy because every manufacturing step is carefully worked out in detail, applications carefully studied.

Put your problem up to us. Our experience will prove very valuable to you. Our service prompt and efficient, suggestions and literature free. Command us.

The *Tycos* Mercury Operated Recording Thermometer

The H&M Division
Taylor Instrument Companies
Rochester, N.Y.

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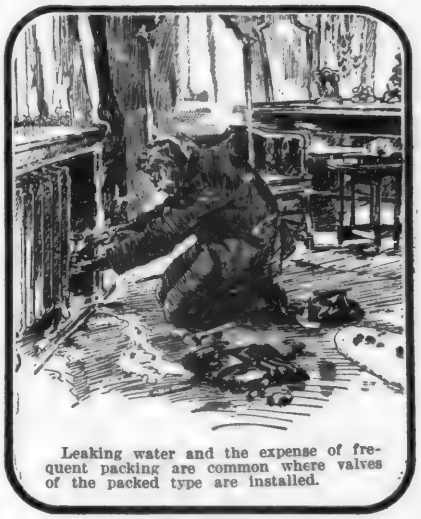
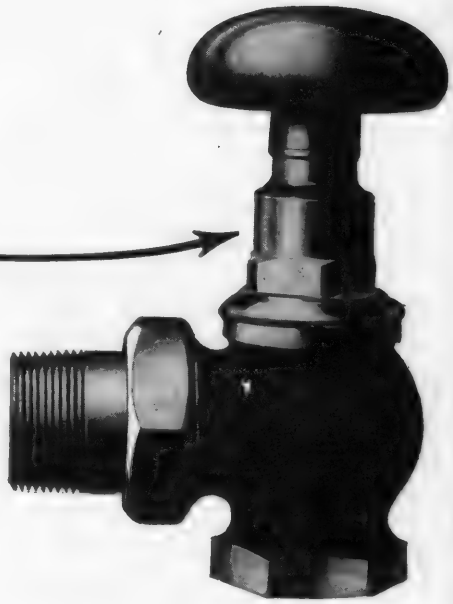
DETROIT PACKLESS RADIATOR VALVES



Leaking water and the expense of frequent packing are common where valves of the packed type are installed.

THE PACKLESS VALVE
ELIMINATES
UPKEEP EXPENSE

Detroit Packless Valves are absolutely tight and they always STAY tight. They give freedom from all the troubles common to valves of the packed type.



Specify Genuine Detroit Packless Valves

DETROIT LUBRICATOR COMPANY
DETROIT, U. S. A.
CANADIAN DETROIT LUBRICATOR COMPANY, LTD. WALKERVILLE, ONTARIO, CANADA

LARGEST MANUFACTURERS OF RADIATOR VALVES IN THE WORLD

to the Chicago office, at 1535 Lytton Building.

Marshalltown, Ia.—Work has begun upon the combined warehouse and foundry for the Lennox Furnace Company, which is being built alongside the company's main factory fronting the Lincoln Highway, east of Twelfth Avenue. The new building will have ground dimensions of 72x280 ft., with an addition on one side 24x240 ft. The front 40 ft. will be three stories high, the remainder being one-story, of the foundry type of construction. The cost of the new building will be $15,000, and constitutes the second unit of what is already the largest factory in the world devoted exclusively to the building of warm air furnaces of riveted steel type.

Hughes Electric Heating Co., Chicago, Ill., manufacturer of electric ranges, ovens and miscellaneous heating devices, will build a new $150,000 plant in Chicago, between the Baltimore & Ohio Terminal Railway, West Taylor Street, Fifty-sixth and Waller Avenue. The new plant will be one story high and will contain 80,000 sq. ft. of floor space.

American Radiator Co., Chicago, Ill., has

ILG

DIRECT CONNECTED BLOWERS

Compact—Efficient—Quiet Running

EASY TO INSTALL

One Nameplate, One Guarantee Covering Fan and Motor

ILG Electric Ventilating Co. 158 Whiting Street CHICAGO, ILL.

Cleveland City Hall equipped with Five Sturtevant Copper Air Washers, Seventeen Sturtevant Fans, and other Heating and Ventilating equipment. Architect, J. Milton Dyer, Cleveland; Engineers, French & Hubbard, Boston; General Contractors, Geo. A. Fuller Construction Co., New York; Heating and Ventilating Contractors, Baker-Smith & Co., New York.

Sturtevant Air Washers (REG. U.S. PAT. OFF.) **in Cleveland City Hall**

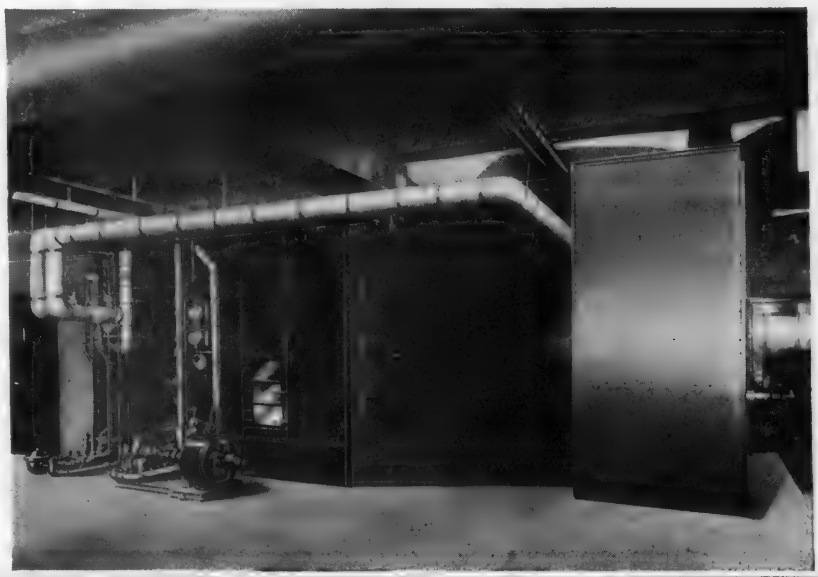
The large number of prominent buildings equipped with Sturtevant Air Washers proves that high-grade engineers and architects realize the many advantages of using this apparatus.

Our Air Washer Department will co-operate with engineers on all problems of Heating, Ventilating, or Air Conditioning.

Copy of specifications or Bulletin 226-V on request.

B. F. STURTEVANT COMPANY HYDE PARK, BOSTON MASSACHUSETTS

AND ALL PRINCIPAL CITIES OF THE WORLD



recently opened new branch offices in Grand Rapids, Mich., and in Providence, R. I. Quarters for the Grand Rapids branch have been taken at 3 Perkins Building, where the company's line of Ideal boilers and American radiators is on display. Clare Shafer is in charge. The Providence branch, which is located in the Turk's Head Building, is in charge of Grant Pierce. The business in the Providence territory was formerly taken care of from the Boston office.

Central Station Heating Notes.

Indianapolis, Ind.—The State public service commission has taken under advisement a petition from the Indiana & Michigan Electric Company to buy the St. Joseph Heating Company, a concern organized at South Bend, Ind., originally to heat a hotel building there. At a recent hearing no price was fixed on the heating property, according to those interested, because it is not completed. Later a purchase price is to be determined and this is to be met with stock of the Indiana & Michigan Electric Company.

York Steam Heating Co., York, Pa., announced an increase in its heating rates, commencing September 1. The increase, it is stated, is due to the higher cost of coal and labor. According to the new rates, steam will be furnished from September 1 to June 1, of any year, as follows: First 50,000 lbs., 55 cents for 1000 lbs.; next 500,000 lbs., 44 cents; next 1,0000,000 lbs., 40 cents; excess over 2,000,000 lbs., 35 cents. Steam furnished from June 1 to September 1 will be charged for at the rate of 55 cents per 1000 lbs.

New Incorporations.

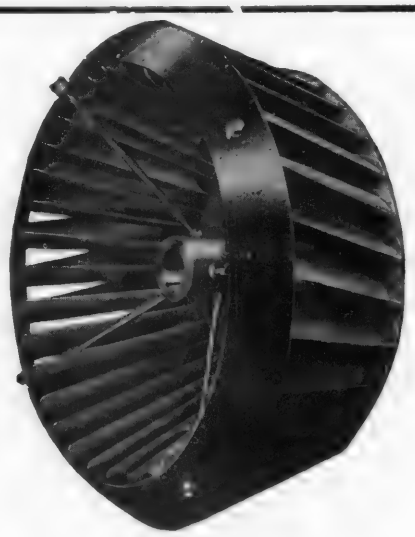
Federal Heating Co., Haverhill Mass., capital $20,000. Incorporators: Charles C. Staples and Edward S. Coburn.

Rolfe Heater Mfg. Co., Columbus, O., capital $15,000. Incorporators: Herman L. Rolf, William E. McCann, James C. Reid, Emma L. McCann and Carrie Rolf.

Pendleton Plumbing Co., Falmouth, Ky., capital $10,000, to conduct a heating and plumbing contracting business. Incorporators: James O. Perrin, John B. Colvin and H. C. Hume.

Root-Johnson Ventilating Co., Indianapolis, Ind., capital $10,000, to manufacture ventilating systems. Incorporators: William R. Root, Ralph C. Root and M. G. Root.

Byron Parker, Inc., Hudson, N. Y., capital $9,000, to deal in heating and plumbing specialties. Incorporators: B. F. Parker, C. A. Parker and G. N. Parker, all of Hudson.



Buffalo
Niagara Conoidal Fans Are Strongest

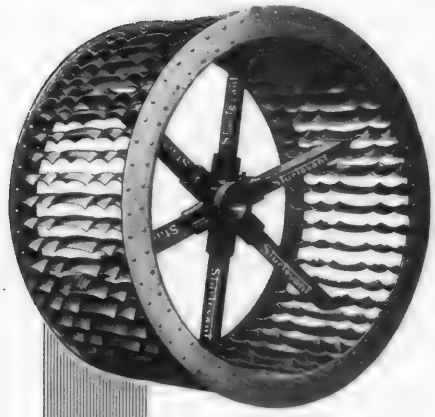
One of the largest American concerns has occasion to use fans for service where sudden starting and stopping is necessary. A testing machine was used to approximate actual working conditions, by bringing the fan wheels from rest to **1500** R. P. M. and stopping in one second.

Fans of a well known make—multiblade type—after several improvements and changes in design made as their best tests **2580** and **1488** cycles of starting and stopping before they went to pieces.

A Conoidal Wheel, the only one offered, and without the advantage of previous test, had made **37333** cycles when the shaft of the testing machine broke, leaving the fan apparently in good condition to go on indefinitely as reported by the buyers' Engineers.

Send for Catalog 201.36

Buffalo Forge Company
Buffalo, N. Y.



Why the Multivane Fan is Superior

THE Sturtevant Multivane Fan is designed intelligently—there is weight where weight is needed, and the distribution of the metal makes for efficiency and continuous service.

The Multivane wheel is light, there is thus less likelihood of bearing trouble and less vibration. The cup-shaped blades handle air very efficiently. The fact that the Multivane Fan has a lighter wheel than other fans, for the same volume of air handled, is a distinctive advantage. There is less centrifugal action tending to tear the fan to pieces.

The casing of the Sturtevant Multivane Fan is heavily-reinforced wherever necessary and so designed generally that the bearings have a sound, substantial support. A heavy casing of this type provides the weight necessary to eliminate all vibration. This is not the case with fans of inferior manufacture where construction is light and where vibration is excessive and the machine goes to pieces after a few years of service.

Sturtevant Fans are made for continuous operation, and we have many fans that have been in operation for 25, 30, or even 40 years.

Write for General Catalog 195-V.

B. F. STURTEVANT COMPANY

HYDE PARK, BOSTON, MASSACHUSETTS
AND ALL PRINCIPAL CITIES OF THE WORLD
Selling Agents for Sanford Riley Stoker Co., Limited
"THE RILEY STOKER"

Sturtevant
(REG·U·S·PAT·OFF·)

Business Changes.

Blackstone Heating Co., Pawtucket, R. I., has been dissolved as a partnership, Joseph F. Bodell retiring. The business will be continued by Henry J. Allsworth, the other partner.

Thompson Heating Co., Columbus, O., has leased the three-story building at 165-167 West Main Street and has fitted it up for the manufacture of the Thompson gas furnace, designed by R. S. Thompson.

Mehring & Hanson Co., Chicago, Ill., heating and ventilating engineers and contractors, has moved to new and larger quarters at 118-120 North Franklin Street, Chicago.

Business Troubles.

James Curran Mfg. Co., New York, steam heating and ventilating contractors and manufacturers, had a petition in bankruptcy filed against it by L. J. Wing Mfg. Co., $630; John Simmons Co., $394; and McNab & Harlin Mfg. Co., $429. It was alleged that the company admitted on July 27 that it was insolvent and unable to pay its debts. The company was incorporated in 1893 and had a capital stock of $50,000. Its affairs have been in the hands of a committee of creditors for some time. Liabilities are reported to be $13,000 and assets, $7,000.

Contracts Awarded.

Wilson & Maples, Sturgeon, Wis., heating new Door County State Bank building at Sturgeon.

Charles Arting, Mansfield, O., heating and ventilating Mansfield General Hospital at Mansfield, for $9,780.76. The plumbing contract went to E. F. Malone, Mansfield, at his bid of $12,298.41.

Thomas F. Lynch, Virginia, Minn., heating and ventilating new high school at Hitterdale for $10,000; also heating and ventilating school building at Bagley for $9,500.

Scott Co., San Francisco, Cal., heating and ventilating Hilgard Hall, at the University of California, Berkeley, for $46,600.

F. A. Clegg & Co., Louisville, Ky., heating, ventilating and wiring E. H. Ewing's

ECONOMY PUMPS

A PUMP FOR EVERY PURPOSE

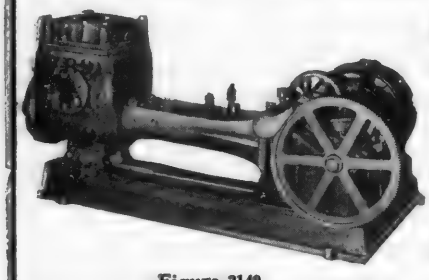


Figure 2149
Economy Motor Driven, Direct Acting Vacuum Pump, Double Acting Type

Automatic Bilge Pumps
Sewage Ejectors and Cellar Drainers
Automatic Condensation Pumps and Receivers
Vacuum Pumps, for two pipe or air line systems—automatic, electric or hand control
Automatic House Pumps and Compression Water Systems

ECONOMY PUMPING MACHINERY CO.
118-118 N. Carpenter St., Chicago
Phones—Monroe 5941-5942

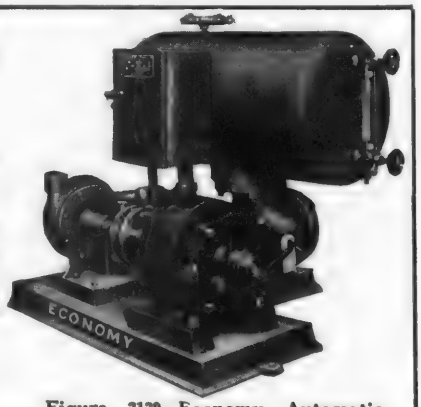


Figure 2129—Economy Automatic Condensation Pump and Receiver for low water lines and underground returns.

AIR CONDITIONING
never involves too complex a problem if you avail yourself of our advice.

Carrier
Engineering Corporation
39 Cortlandt St., New York
Boston Philadelphia Buffalo Chicago

¼ H.P. Equipment

Spencer Turbine Vacuum Cleaners
are manufactured in sizes from ¾ H. P. to 40 H. P.
Send for catalogue
SPENCER TURBINE CLEANER COMPANY
HARTFORD, CT.

A constant volume of perfectly conditioned washed air floods the entire plant through the registers, shown in the illustration, via underground ducts. This is the Prest-O-Lite installation.

"Sirocco" and the World's Largest Manufacturers

The Prest-O-Lite Company, Incorporated, Indianapolis, is one among several hundreds of the "World's largest manufacturers" who are users of "Sirocco" Fans and other American Blower Company products.

The "Sirocco" System for Heating, Ventilating and Air Conditioning has been and can be installed in what would otherwise be waste space. The apparatus at the Prest-O-Lite Company, for example, is placed directly under the roof on a platform supported by concrete pillars. The washed and heated air is then driven down through underground ducts and distributed through openings in the walls.

"The Comfortable Shop"—Book No. 9A—shows many other interesting installations. Where shall we send YOUR copy?

American Blower Company

Detroit, Michigan

Branches Everywhere

Sons dairy building for $31,000; vacuum heating St. Francis Academy buildings, Owensboro, for $3,000; heating Translyvania University buildings, Lexington, for $10,000, and installing steam service lines from the Seelback Hotel to Fourth and Green streets, Louisville, for $4,000.

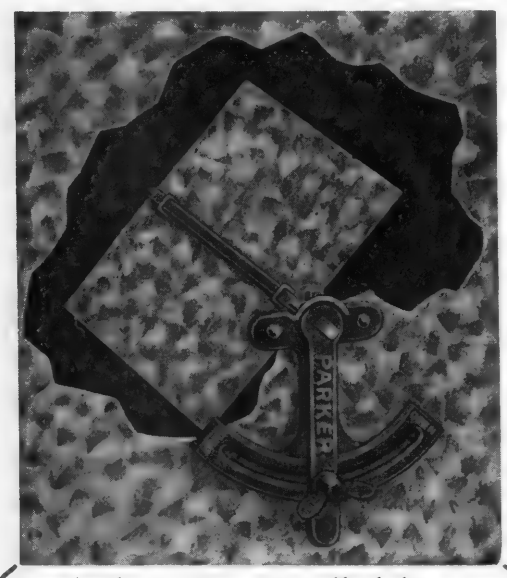
Lane-Pyke-Warkhoff Co., Lafayette, Ind., heating and plumbing Ingram-Richardson Enameling Co.'s factory building at Frankfort, for $12,000. The Ingram-Richardson company is moving its plant to Frankfort from Beaver Falls, Pa.

Lafayette Plumbing & Heating Co., Lafayette, heating and ventilating new consolidated high school, in Highlands, for $7,000.

M. A. Dame & Son Co., Worcester, Mass., heating and plumbing new Conomo Avenue School, Lynn, for $26,474.

W. C. Sheehan & Co., Omaha, Neb., heating and plumbing school buildings at Lewis, Ia., for $12,068; at Sidney, Ia., for $4,220; and at Benson, Neb., for $6,084.

James Smuth Plumbing & Heating Co., Spokane, Wash., heating and ventilating new hospital building at Missoula, Mont., for $30,000. This company also has the plumbing contract, amounting to $30,000.



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Parker Damper Quadrant
—the ideal combination
Have you a copy of our booklet?
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Makers of PARKER PRODUCTS
780 East 135th Street, New York
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AIR CONDITIONING APPARATUS

WEBSTER Air Washer and Air Conditioning Apparatus is constantly demonstrating its ability, under a wide variety of exacting conditions, to effect and maintain any desired temperature or humidity.

Whenever a highly efficient and thoroughly dependable air washing, air cooling or air conditioning system is required, WEBSTER Apparatus, by reason of its exclusive advantages, is selected by engineers, architects and owners.

No air conditioning problem is too difficult for us to solve. Our air conditioning engineering staff is second to none in existence. Give us the opportunity to prove this by taking up your next air conditioning problems with us.

We guarantee results in any problem we undertake.

Write us Today for Catalogue A-37.

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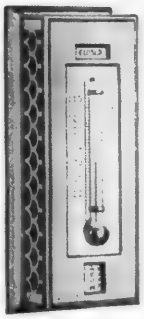
Established 1888. Branch Offices in Principal Cities

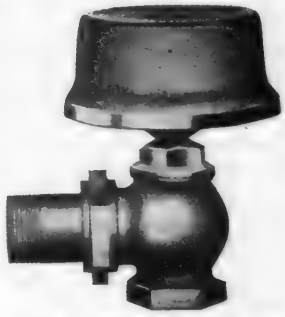
First in the Field



The marvelous little fool-proof thermostat

Automatic temperature control for buildings originated with the **Johnson System of Temperature Regulation.**

While various imitations in the way of regulating devices have been offered to the heating trade, the JOHNSON SYSTEM is the recognized standard.



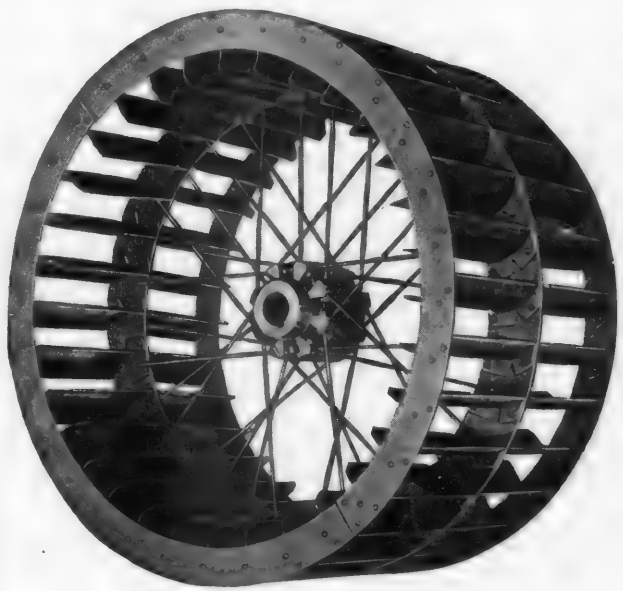
The indestructible sylphon metal diaphragm valve

It costs no more to install the JOHNSON SYSTEM than inferior products, so why assume any risks?

Communicate with our nearest branch in regard to your temperature regulation requirements. Our co-operation is yours for the asking. You can reach us overnight.

The Johnson Service Company

Milwaukee, Wis.



For Heating, Ventilating, Drying and Mechanical Draft Purposes use the

PLEXIFORM FAN

because of its high efficiency, great strength, lightness and low cost of installation.

Plexiform wheel construction is as adaptable for double width as for single width fans, and is the only type of multiple blade wheel fan that is equally adaptable for high or low pressures without change in design and construction.

We have Fans of standard Plexiform construction handling air at —50 deg. and gases at 1000 deg. temperature.

Write for catalogs.

BAYLEY MANUFACTURING CO., Milwaukee, Wis.

Portland, Ore.—Bids were received as follows for the mechanical equipment, including heating, plumbing and electric wiring, of the U. S. Post Office in Portland: J. F. Shea, Portland (lowest bidder), $76,138; Appling-Griggs Co., Portland, $82,200; Kendall Heating Co., Portland, $94,590; Fox & Co., Portland, $79,782; Rushlight & Hastorf, Portland, $88,070; W. G. McPherson, Portland, $110,000; Robt. Dalziel, San Francisco, $91,424; C. Irving Plumbing & Heating Co., Denver, $88,937; G. A. Kees, St. Paul, $76,869; Sodemann Heating & Power Co., St. Louis, $91,967; General Heating & Ventilating Co., Milwaukee, $91,138; Turner Co., San Francisco, $100,650; Healy Plumbing & Heating Co., St. Paul, $81,977; T. J. Sheehan Co., St. Louis, $101,077; Wenzler & Ward, Seattle, $79,366.

St. John Plumbing & Heating Co., Colorado Springs, Colo., heating and plumbing new $200,000 station for the Santa Fe Railroad in Colorado Springs.

Gillis & Geoghegan, New York, heating new $700,000 garage and storage building for John Wanamaker at 726-730 Broadway. Wells & Newton Co., New York, has the plumbing contract.

Columbus Heating & Ventilating Co., Columbus, O., heating and ventilating new high school building in that city for $6,500.

Peters-Eichler Co., St. Louis, Mo., heating and ventilating Bates School, in St. Louis, for $31,661.

Ross Expansion Joint Designed by Richard Ruppell.

In connection to the description of the Ross expansion joint, which appeared in the April, 1916, our attenion has been called to the fact that this expansion joint, which is manufactured by the Ross Heater & Mfg. Co., Inc., Buffalo, N. Y., was originally designed by Richard Ruppell, of New York, a well-known heating and ventilating engineer of that city.

Business Chances.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until October 16, 1916, for the construction complete of the U. S. Post Office at Dickinson, N. D.

Until October 19, 1916, for the construction of the U. S. Post Office at Du Bois, Pa.

Until October 20, 1916, for the construction complete of the U. S. Post Office at Bayonne, N. J.

Until October 23, 1916, for the extension, remodeling, etc., of the U. S. Post Office at Boise, Idaho.

Until October 30, 1916, for the construction complete of the U. S. Post Office at Burlington, N. C.

Until Ocober 31, 1916, for the construc-

Humidity at Low Cost

is obtained with the

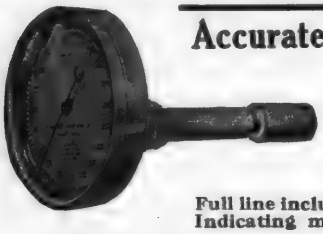
SĀVŌ Air Moistener

Can be placed on the back of any radiator, out of sight and will supply the desired amount of moisture to any steam or hot water heated room. Especially adapted for houses, offices, schools and hospitals.

Specify them on your next job and save the cost of an expensive humidifying system.

Three sizes, $2.00, $1.75 and $1.00. Write for free illustrated booklet.

SAVO MANUFACTURING CO., 39 South La Salle St., Chicago, Ill.



Accurate Service Is Assured When You Use

Standard Indicating and Recording Thermometers

Guaranteed Correct

Full line includes seven types of recording thermometers and a special line for mechanical uses Indicating mechanical thermometers are furnished with extensions from 2 to 30 in. in length

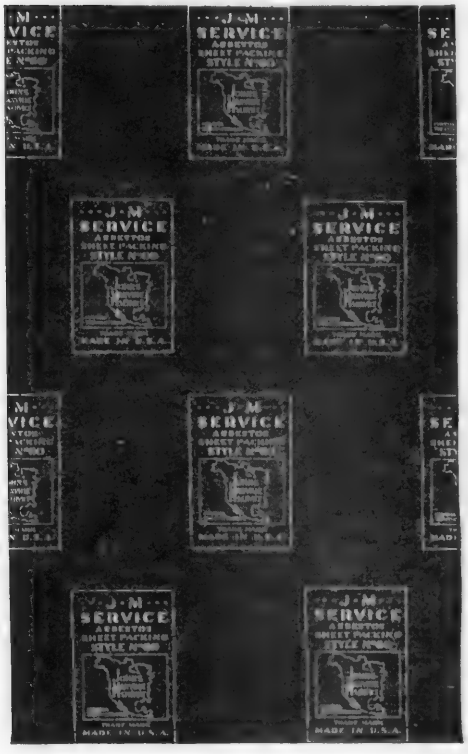
All thermometers are double and not breakable.

STANDARD THERMOMETER COMPANY Clinton and Shirley Streets **BOSTON, MASS.**

Johns—Manville

COVERS THE CONTINENT

Serves more people in more ways than any other institution of its kind in the world.



Announcement:

On October 1, 1916, we discontinued the sale of the sheet packing known as J-M Permanite and we are now supplying an asbestos sheet packing of our own manufacture known as

J-M SERVICE PACKING

THIS sheet is made of long asbestos fibre, felted together and bonded with heat-resisting compounds. It is an "all around the plant" packing and can be used at any temperature or pressure and in every type of service.

The fifty years that we have manipulated asbestos fibre and manufactured sheet packing, plus the many years of experience in selling Permanite and studying its performance under every service, especially high pressures and severe temperatures, enable us to embody many improvements in J-M SERVICE SHEET PACKING.

The improved process and method which our experts have decided upon in manufacturing J-M SERVICE SHEET PACKING, will make this sheet a packing to be depended upon to pack durably and tightly any place in your plant where a sheet packing can be used.

The quality of J-M SERVICE SHEET PACKING will be even better than any sheet packing we have before offered, yet the price will be the same.

Remember the name—J-M SERVICE SHEET PACKING. And when your first order arrives, look for a new and better American packing, manufactured under the rigid supervision of modern packing experts and backed to the limit by Johns-Manville Responsibility.

H. W. JOHNS-MANVILLE CO.

Executive Offices, 296 Madison Avenue, New York

Boston	New York		St. Louis
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Service and Responsibility

tion complete of the U. S. Post Office in Woodbury, N. J.

Until November 13, 1916, for the installation complete of the mechanical equipment (except elevators and lighting fixtures) of the U. S. Post Office and Court House in Birmingham, Ala.

Spokane, Wash.—The old roller skating rink in Spokane will be enlarged and converted into an ice skating rink, at an estimated cost of $20,000. It is stated that the building will be piped for artificial freezing of the water.

BUSINESS OPPORTUNITY FOR VENTILATING PEOPLE.

I am offering for sale outright the patent on the best Electrical Ozone Air Purifying Apparatus on the market, *or will lease all rights to reliable manufacturing companies, or will sell shop rights to reliable companies,* or will sell the ozonators in large quantities to reliable electrical or ventilating companies or companies who will push the sale of this apparatus. *By the addition of this device you will open up a new field* for small transformers, fans, small motors and motor generators and *blowers. The demand is coming rapidly and profits on the business will be very remunerative to those who embark in the business early.*

My device has been tried out for two years in one or more laundries, theatres, cafés, offices, residences, meat markets, stores, city jails, and toilet rooms in State House for deodorizing. These machines have proven successful. All installed on approval and all sold.

This will be a valuable addition to any electrical or ventilating company. If interested, address S. G. Hunter, 1117 22d street, Des Moines, Iowa, sole owner.

BUSINESS OPPORTUNITY.

The President, who owns a controlling interest in a prosperous going concern in the heating line, wants to replace the present General Manager about January 1st next with a live, energetic, experienced man who can fill in a lot of vacant space with "pep." The new man must have sufficient capital—about $25,000—to purchase the stock of the present manager. The position is a nice one and the right man can have a good salary. Address Longacker, care of Heating and Ventilating Magazine, 1123 Broadway, New York.

"CONNERSVILLE"

VACUUM CLEANERS EVERYWHERE

For installation in Residence, Apartment, School, Office Building, Sanitorium, Hotel, Factory, Church, Theatre, Hospital, Laundry, Library, Public Building, etc.

The Sanitary Way

Buy a "CONNERSVILLE" and Avoid Dust Dangers and Daily Drudgery

United Vacuum Appliance Co.
Connersville, Ind.

Single Pipe Type

Steamo and Vapo Air Moisteners

Made in two kinds, one for Steam Systems, the other for Vapor and Vacuum Systems.

Each kind is made in four types for different situations.

Each type is made in two or three sizes.

These moisteners are not hid behind radiators but stand out so that it may be plainly observed that they are doing their work.

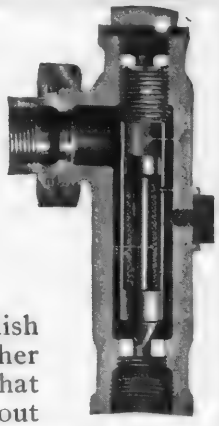
The Air Moistener Co.
28 N. Market St.
Chicago, Ill.

HEATING ENGINEERS

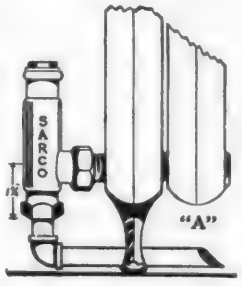
Insisting on efficient and reliable results

SPECIFY

RADIATOR TRAP SARCO



BECAUSE they have found by actual tests that they can accomplish certain results with the Sarco that are unobtainable with other styles of traps.—That they can install the Sarco at any angle.—That they can thoroughly clean out the system at any time without removing trap from radiator.—That Sarco traps are absolutely noiseless, non-freezable, impossible to airbind, in fact, that every objectionable feature found in radiator traps has been left out of the Sarco.

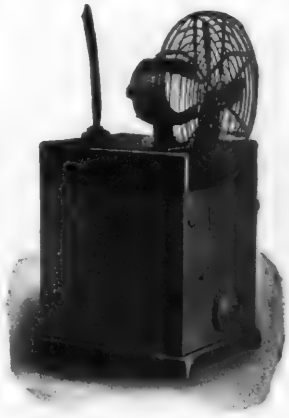


We can add numerous reasons to the above why you should use Sarco. Write and ask why Sarco is used on Low Pressure, Vapor and Vacuum Heating Systems.

SARCO COMPANY, Inc.

CHICAGO Woolworth Building **DETROIT**
NEW YORK

FRESH AIR



is of utmost importance for the comfort of humanity.

SPRAGUE ELECTRIC OZONATORS

used as an adjunct to ventilation, freshen the air and eliminate unpleasant odors in crowded rooms, stables, toilets, factories, etc.

Combination Ozonator and Electric Fan

Low cost of maintenance

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Why install one large unit to heat a café or grill room which is in use perhaps twenty hours of the day, and also a room which is used perhaps only four hours a day? Investigate the

Sturtevant Electric Heat Blower

(REG. U.S. PAT. OFF.)

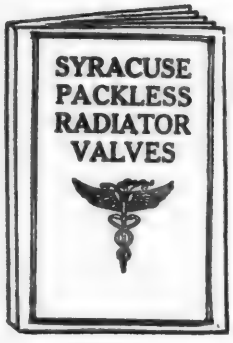
The Ideal Small Heating Unit

Send for Bulletin 219-V

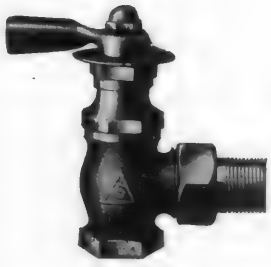
B. F. Sturtevant Co. HYDE PARK, BOSTON, MASS.

And all principal cities of the world.

THREE NEW ONES



Catalogue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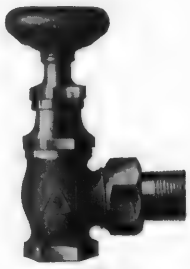
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ALL OF THEM DANDIES!

Send for the catalogue which tells about these new style valves.

SYRACUSE FAUCET AND VALVE COMPANY

Office and Factory **Syracuse, N. Y.**

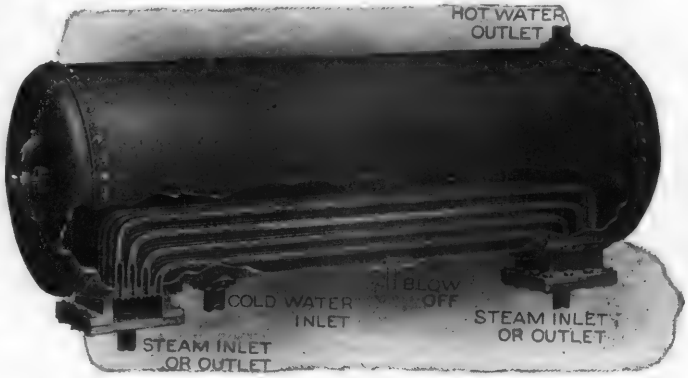
Sweet's Catalogue Page 1249
GEO. A. WELD CO., 79 Milk Street, Boston

220-224 West 42nd St. **New York City**

THE ⌐¬ SHAPE TUBES EXPLAIN THE SUCCESS of the

PATTERSON HOT WATER TANK

for heating water for domestic or manufacturing purposes. Both ends of each seamless brass tube are expanded into heavy cast-iron tube-heads with an improved roller expander. Their shape provides for the free contraction and expansion of each individual tube without straining, so there is no danger of leakage.



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BOOKS ON HEATING AND VENTILATION

DISTRICT HEATING. By S. Morgan Bushnell and Fred. B. Orr. This book not only imparts a general knowledge of district heating, but contains many points on economical operation, as illustrated in the methods practiced by central station heating companies which have been successful in this field. Comparative data are also presented indicating the prices that can reasonably be charged for heating service. Size 6 x 9 in. 300 pages. 81 figs. Cloth, $3.00.

CENTRAL STATION HEATING. By Byron T. Gifford. This work presents the most advanced practice in central station heating, both steam and hot water, and is an invaluable guide, not only to the engineer, but to municipalities and public service commissions where district heating is being, or will be, used. 208 pages, with 42 figures, including 50 pages of miscellaneous engineering data. Size 6x9½ in., bound in flexible leather. Price, $4.00.

VACUUM CLEANING SYSTEMS. By Maxwell S. Cooley. A reliable data book for engineers, architects, heating contractors and plumbers interested in the correct design and installation of mechanical cleaning plants. Size 6 x 9 in. 244 pages. 105 ills. 20 tables. Price, $3.00 postpaid.

VENTILATING DUCTS. By C. E. Pearce. A set of six tables printed on heavy Bristol board, for rapidly estimating the superficial area and weights of galvanized iron rectangular ducts used in ventilating work. Size 7 x 9 in. Price, 50 cents.

ELEMENTS OF HEATING AND VENTILATION. By Arthur M. Greene, Jr. A text book for technical students and a reference book for engineers. 330 pages. Size 6 x 9½ in. 223 ills. Price, $2 50 postpaid.

MECHANICS OF HEATING AND VENTILATING. By Konrad Meier. Including a series of ten charts containing data relating to the flow of water, steam and air, collected by Mr. Meier during an experience of 26 years in heating and ventilating work, both in this country and abroad. Each of the charts replaces a series of tables on the subject, giving at a glance the result of a calculation from any combination of factors. 161 pages, illustrated, with ten large charts. Size 6 x 9 in. Price, $5.00. Separate sets of charts, printed on cloth, with lines in different colors and mounted on boards. Single charts, $1.50. Sets of ten charts, $15.00.

HEATING AND VENTILATING BUILDINGS, a standard manual for heating engineers and architects. By Prof. R. C. Carpenter. Sixth edition, largely rewritten. 577 pages, 277 illustrations, 8vo, cloth, $3.50.

HANDBOOK FOR HEATING AND VENTILATING ENGINEERS. By Prof. James D. Hoffman and Benjamin F. Raber. The latest book on this subject. Unusually comprehensive. 320 pages, with 45-page appendix. Size 4½ x 6¾ in., bound in flexible leather. Price, $3.50.

PRACTICAL MANUAL OF STEAM AND HOT WATER HEATING. By E. R. Pierce. Especially useful to men engaged in installing steam and hot water heating apparatus. Easily understood and comprehensive. Boiler ratings exhaustively treated. 359 pages. Size 5¼ x 8½ in. Cloth, $2.50.

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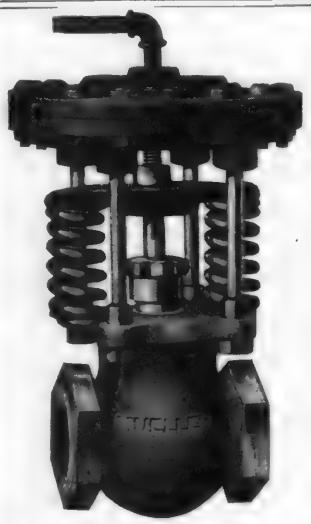

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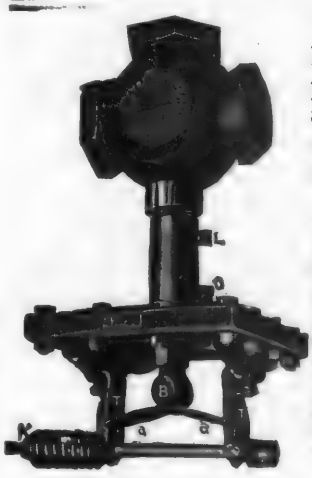

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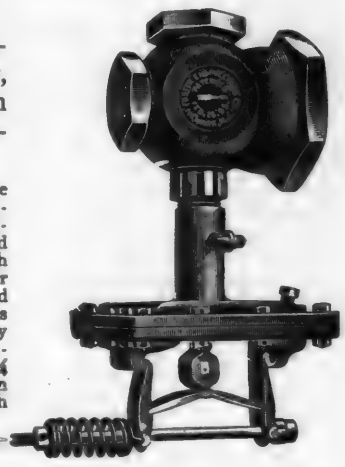

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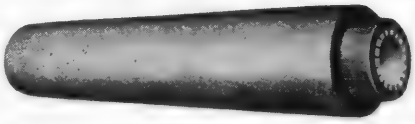

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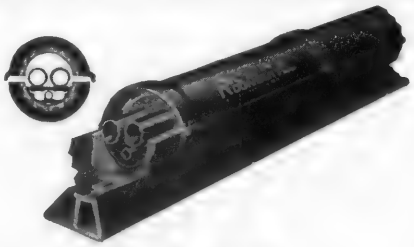

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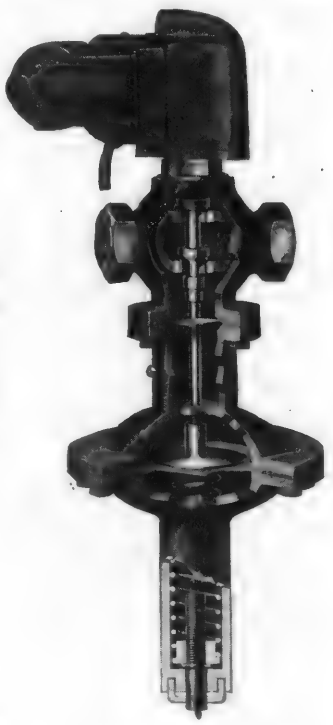

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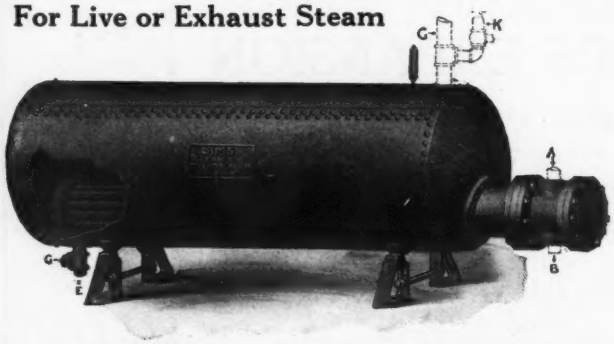

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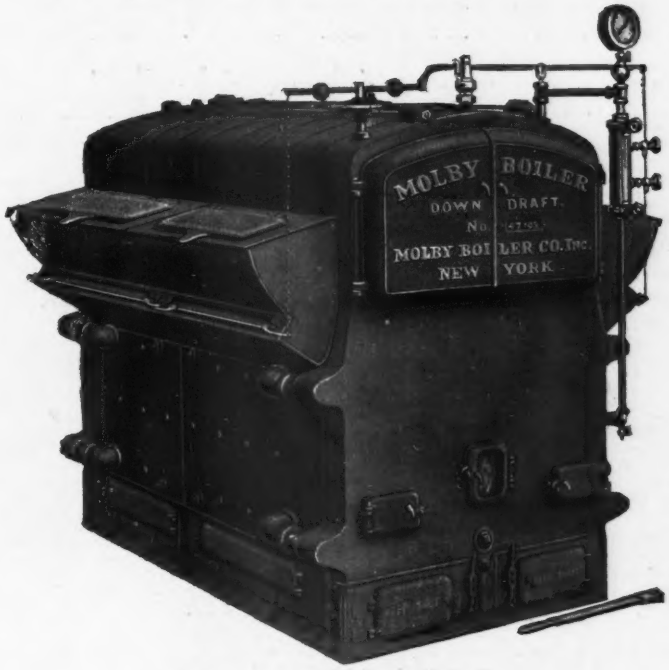

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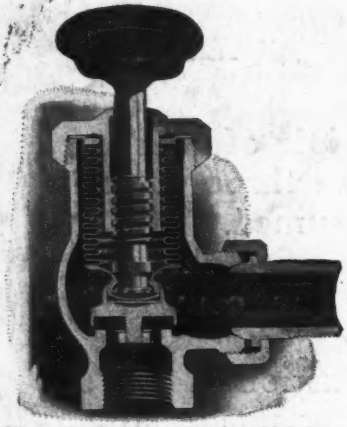

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